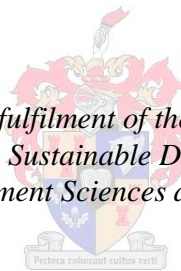


Barriers to, and policy opportunities for, the growth of renewable energy technologies in South Africa: Rethinking the role of municipalities

by
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of Master of Philosophy in Sustainable Development in the Faculty of
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Cr tki2014

Declaration

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Date: February 2014

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Abstract

Amid the climate change crisis of the 21st century, South Africa faces its own, tailor-made challenges. In its attempt to contribute to the global effort to mitigate climate change and achieve sustainable development, South Africa faces the challenge of a history steeped in cheap electricity - the curse of an abundance of coal. The municipality, as the lowest leg of governance, currently finds itself at a tough nexus, involving; municipal mandates to provide basic services; the possible financial risks of implementing RETs; the regulatory ambiguity surrounding electricity generation and distribution jurisdiction; and the necessary implementation of RETs as a means of addressing the growing risk of revenue loss from reduced electricity sales as consumers install their own RETs, and as a contribution to national climate change mitigation. This nexus is herein referred to as the ‘municipal dilemma’.

This thesis, via a complex systems approach, explores the major barriers and policy opportunities in the implementation of renewable energy technologies (RETs) by municipalities embedded within the larger ambit of the South African government, as they attempt to address what the author has termed the ‘municipal dilemma’. What is especially interesting and relevant about a complex systems approach is the notion of learning and therefore adaptability. In light of municipalities and their role in the South African context, the notion of systems learning affords a unique perspective into the municipal dilemma and means of overcoming it. From a literature analysis of policy, through to a specific case study of Hessequa municipality, this study sought to assist municipalities in addressing this dilemma.

South Africa’s energy and municipal management policies starting from the Constitution, is found to be conducive to the growth of RETs. Furthermore, there are clear channels through which municipalities can engage with these new technologies to address the municipal dilemma. What is seen to hinder this process is a web of institutional, political and regulatory barriers stemming from the over-politicization of the country’s energy sector - a direct result of a long history entrenched in coal-fired electricity generation.

What was found lacking in the South African energy debate was the perspective of the municipality itself, which is ultimately tasked with catering for the energy needs of South African citizens while participating in national efforts. The notion that municipalities are best positioned to be influential in the growth of RETs is reinforced by the literature explored and

through a complex systems approach. To effectively play their role, municipalities must: (a) be creative and bold in their development of appropriate policies to support RETs; (b) align their efforts with provincial and national programmes and simultaneously influence these programmes through municipal experience; (c) take advantage of systems in place, such as the Integrated Development Plan (IDP) process, to gradually build capacity within the municipality to manage increasingly complex RET implementation; (d) develop long-term strategies which, as per the tenets of complex systems theory, must feed from and into the ever-changing national and global landscape.

This thesis posits that the municipal dilemma not only needs to be addressed, but offers the municipality a unique opportunity to rethink its role in the South African context. It has been found that a conducive regulatory environment is on the rise in the South African energy context. This environment, however, still requires much input from municipalities which are well positioned to offer direction to the policy creation process. In doing so, municipalities not only address the municipal dilemma, but also take their place as custodians of sustainable development.

Opsomming

Te midde van die krisis van die 21^{ste} eeu, naamlik die uitdaging van klimaatverandering, staan Suid-Afrika sy eie, unieke uitdagings in die gesig. Met die nodigheid om by te dra tot die globale poging om klimaatsverandering te versag en volhoubare ontwikkeling mee te bring, is Suid-Afrika gekonfronteer met die uitdaging van 'n geskiedenis 'ryk' in goedkoop elektrisiteit - die vloek van 'n oorvloed steenkool. Hierdienooreenkomstig bevind die munisipaliteit, as die laagste been van regering, homself in 'n moeilike krisispunt, naamlik die handhawing van die grondwetlike mandaat om basiese dienste te verskaf, en om ekonomiese ontwikkeling te verseker, maar tog by te dra tot die land se volhoubare ontwikkeling. Dit is uiters moeilik om alle aspekte genoegsaam aan te spreek, en hierna word verwys as die munisipale dilemma.

Ter oorweging van die munisipaliteit as ingebed in 'n groter stelsel, naamlik die Suid-Afrikaanse konteks, en met 'n komplekse stelselsbenadering om die munisipale dilemma aan te spreek, ondersoek hierdie tesis die groot struikelblokke tot, en beleidsgeleenthede vir, die implementering van hernubare energietegnologie deur munisipaliteite. In terme van die komplekse stelsels benadering is veral belangrik die opvatting van leer en dus aanpasbaarheid van die stelsels en hul relevansie vir die Suid-Afrikaanse konteks. Uit 'n ontleding van die beleidsliteratuur, en deur 'n spesifieke gevallestudie van Hessequa munisipaliteit, poog hierdie studie om munisipaliteite te help in die aanspreek van hul dilemma.

Daar is gevind dat Suid-Afrika se energie- en munisipale bestuursbeleid, vanaf die Grondwet, die groei van hernubare energietegnologie bevorder. Verder is daar duidelike kanale waardeur munisipaliteite betrokke kan raak by hierdie nuwe tegnologie ten einde die munisipale dilemma aan te spreek. Hierdie proses word wel verhinder deur 'n web van institusionele, politieke en regulatoriese hindernisse, wat spruit uit die oorverpolitisering van die land se energie-sektor; 'n direkte gevolg van 'n lang geskiedenis verskans in steenkool-aangedrewe opwekking van elektrisiteit.

Wat ontbreek in die Suid-Afrikaanse energie-debat is die perspektief van die munisipaliteit self, wat uiteindelik getaak is met die adressering van die behoeftes van die Suid-Afrikaanse samelewing, met gelyktydige deelname aan nasionale pogings. Die plaaslike en globale gevallestudies lig talle gemeenskaplike temas uit en vorm die basis van die gevolgtrekkings van hierdie tesis. Die idee dat munisipaliteite die beste geposisioneer is om invloedryk te

wees in die groei van hernubare energietegnologie word versterk deur die literatuur ondersoek en deur middel van 'n komplekse sisteem benadering tot die gevallestudies. Om effektief te wees in hul rol, moet munisipaliteite (a) kreatief en dapper wees in hul ontwikkeling van toepaslike beleide om dié tegnologieë te ondersteun; (b) hul pogings in lyn bring met provinsiale en nasionale programme en terselfdertyd hierdie programme beïnvloed deur munisipale ervaring; (c) voordeel trek uit stelsels wat reeds in plek is om geleidelik kapasiteit op te bou binne die munisipaliteit om die toenemend komplekse hernubare energie implementering te bestuur; en (d) langtermyn strategieë ontwikkel in die steeds veranderende nasionale en internasionale landskap.

Hierdie tesis postuleer dus dat die munisipale dilemma nie net aangespreek moet word nie, maar bied die munisipaliteit 'n unieke geleentheid om sy rol in die Suid-Afrikaanse konteks te heroorweeg. Wat bevind is, is dat toepaslike beleid reeds bestaan en dat munisipaliteite hul plek kan inneem as bewaarders van volhoubare ontwikkeling.

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List of abbreviations and acronyms

AMEU -	Association of Municipal Electricity Utilities
ANC -	African National Congress
CDM -	Clean Development Mechanism
CoCT-	City of Cape Town
CRSES -	Centre for Renewable and Sustainable Energy Studies
CSP -	Concentrating Solar Power
DED -	Department of Economic Development
DoE -	Department of Energy
DSM -	Demand Side Management
EE –	Energy efficiency
ESCO -	Energy Supply Company
GST -	General Systems Theory
IDP –	Integrated Development Plan
IPP –	Independent Power Producer
KZN -	KwaZulu-Natal
MEC -	Minerals-Energy-Complex
MFMA -	Municipal Finance Management Act
MOU –	Memorandum of Understanding
NERSA -	National Energy Regulator of South Africa
NGT -	Nominal Group Technique
PBMR -	Pebble Bed Modular Reactor
PPP –	Public-Private Partnership
PV –	Photovoltaic
RDP -	Reconstruction and Development Programme
RE –	Renewable Energy

RETs –	Renewable Energy Technologies
REIPPPP -	Renewable Energy Independent Power Producer Procurement Programme
REN21 –	Renewable Energy Policy Network in the 21 st Century
R&D –	Research and Development
SU -	Stellenbosch University
SWHs -	Solar Water Heaters
UNFCCC -	United Nations Framework Convention on Climate Change

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Chapter 1 - Introduction

The global effort against climate change manifests itself in numerous forms, from land reclamation through reforestation and soil restoration, to carbon sequestration and the search for alternative energy sources. Each member-nation of the global community contributes to this effort in its own way, and while doing so, faces somewhat unique challenges. South Africa, a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, is one such member. As a signatory to these global commitments, South Africa must find means of achieving sustainable development and even redressing some of the damage that has resulted from decades of fossil fuel based economic growth. The search for alternative, sustainable, energy sources is one such means, and herein lays some uniquely South African challenges as the country seeks widespread implementation of renewable energy technologies (RETs).

To implement national efforts, the grass-root level of governance must be brought on-board: enter municipalities. Brent, Guy & Mosdell (2012: 20) indicate that at the municipal level “renewable energy programmes face a number of general challenges and barriers that limit significant widespread deployment”. These challenges include what Painuly (2000) terms: technical, market, political and institutional, and social barriers. The manifestation of these various barriers is often interlinked and cannot be fully accounted for by focusing on a single barrier. This notion of ‘a system of barriers’ will inform the ensuing discussion on overcoming the barriers to RET implementation at the municipal level.

The call for a municipal-headed effort stems from an analysis of the various barriers inhibiting national government from facilitating the widespread implementation of RETs, namely the deep political and economic complexities that the apartheid era has left in the country. The technological lock-in that South Africa finds itself in today is a direct result of the country’s history and the heavy dependence on coal-fired electricity generation. The interests of powerful political and economic players, such as Eskom and the ruling party of South African (Krupa & Burch, 2011), are inherently opposed to any significant or immediate RET growth effort. This is discussed in later sections. The municipality, however, is found to be constitutionally mandated to provide certain basic services and to do so sustainably (Republic of South Africa, 1996); and is furthermore well positioned close to its citizenry, giving it a unique perspective of the needs of South Africans and the

possible benefits of implementing RETs. Throughout this ensuing discussion, the implementation of RETs refers to the use of RETs to generate electricity for consumption.

1.1. Background to the study

The immediate context of this study is the nexus between: municipal mandates to provide basic services; the possible financial risks of implementing RETs; the regulatory ambiguity surrounding electricity generation and distribution jurisdiction; and the necessary engagement, by municipalities, with RETs as a means of addressing the growing risk of revenue loss from reduced electricity sales as consumers install their own RETs, and as a contribution to national climate change mitigation. This nexus is herein referred to as ‘the municipal dilemma’. Brent et al. (2012: 21) allude to this same dilemma in that:

“Decision making with regard to RE [renewable energy] and EE [energy efficiency] projects is facilitated if the decision makers ... are assured that the decision to embark on the project in question is justified from a governance and mandate perspective.”

Janisch, Euston-Brown & Borchers (2012: 1) demonstrate another facet of the municipal dilemma, noting that “[e]lectricity revenue and city financial survival is closely linked in many South African municipalities, due to our particular history of municipalities operating as electricity distributors”. This fragile dependence on the sale of (Eskom generated- Eskom being the national electricity utility, generating well over 90% of electricity consumed in South Africa) electricity, mostly to fund the provision of other basic services, adds further impetus to address the ‘municipal dilemma’. The authors explain that,

“South Africa is being hit by a rapidly changing electricity sector financial situation due to fast rising national grid electricity prices that can’t be readily absorbed by users, coinciding with rapidly decreasing costs of small solar PV, and global warming pressures that accelerate energy efficiency implementation such as solar water heaters” (Janisch et al., 2012: 8)

It is not in the municipality’s favour either that municipal management legislation, such as the Municipal Finance Management Act (MFMA) 56 of 2003 (Republic of South

Africa, 2003) are seemingly punitive in their regulation of public finance management and the undertaking of risks; appearing to leave very little room for failure. Further unpacking the municipal dilemma reveals more challenges to municipalities, more so with the recently approved 8% average yearly electricity tariff increases over the next five years (Creamer Media, 2013). Considering that “the utility’s [Eskom] prices had already trebled between 2007 and 2012” (Creamer Media, 2013), municipalities run the risk of losing fairly significant portions of their revenue at the advent of renewable energy generation by their customers (Janisch et al., 2012; Trollip, Walsh, Mahomed & Jones, 2012). Janisch et al. (2012) indicate that in the past, fears of revenue loss from RETs resulted in resistance by service providers, but that in this day and age, consumer shifts to RETs are widely anticipated and accepted. Estimates from a modelling exercise by Janisch et al. (2012) predict a possible revenue loss of around 4.5% of total revenue from technologies such as PV and solar water heaters (SWHs). Ultimately, if municipalities are to secure their financial stability and meet their mandates, they must address the ‘municipal dilemma’.

However, Brent et al. (2012: 22) point out that there is hope, in the form of the country’s Constitution, sections of which indicate that people have a right to “ecologically sustainable development and use of resources” and, as mentioned, it is local government’s mandate to ensure this right. Indeed various municipalities, such as the City of Cape Town (CoCT) and eThekweni Municipality have taken on this mandate and developed and executed strategies to implement RETs. Hessequa Municipality, which will be used in a case study later in this discussion, has developed a “Green Vision” setting targets for the municipality’s carbon footprint and renewable energy use (Hessequa Municipality, 2012). It is within this uncomfortable and yet necessary space that this study emerges.

1.2. Problem statement

Creswell (2009) indicates that for a research problem to become clear, it is necessary for the researcher to ask what the need for a study is. The most immediate need for this study is to help municipalities address the ‘municipal dilemma’; an effort that will have multiple, positive, knock-on effects; ultimately addressing higher level needs such as attaining sustainable development. Thus, the research problem at hand *is* the municipal dilemma. In addressing this issue, this study takes on a specific focus, elaborated in section 1.3.

1.3. Research aims and objectives

This study seeks to address the municipal dilemma by: (a) identifying and understanding the barriers to the implementation of RETs in South Africa, via the municipal level of government; (b) highlighting the policy opportunities for municipalities to implement RETs; and (c) finally, correlating the findings of this literature analysis with findings from actual engagement with a municipality - through a case study of Hessequa Municipality. It is hoped that the reconciliation of a literature analysis and the actual perspectives of the municipality will provide a deeper insight into the municipal dilemma and therefore means to overcoming it. The objectives of this study, as milestones to reaching this goal, are therefore to:

- ✓ Identify energy and municipal management legislation conducive to the implementation of renewable energy technologies.
- ✓ Determine the major barriers to the implementation of RETs in South Africa.
- ✓ Determine the municipality's perspective of the barriers to municipal implementation of renewable energy generation.
- ✓ Provide relevant lessons on successful implementation of renewable energy generation from international and local case studies.
- ✓ Provide succinct recommendations, applicable to a majority of South African municipalities, on a way forward.

Literature on the diffusion of RETs explores a plethora of barriers, which manifest themselves in different forms depending on a multitude of conditions, including; the country of concern and the technology in question (Painuly, 2000; Sebitosi & Pillay, 2008a, 2008b; Edkins, Winkler & Marquard, 2009; Pegels, 2010; REN21, 2012). Thus, though this discussion explores barriers to RETs, the focus is especially on those barriers applicable to the South African context, and especially considering their implementation at the municipal level.

It is important here, to define what is referred to by RETs at the municipal level. These are renewable energy technology systems including solar photovoltaic (PV) systems, solar water heaters (SWHs), wind turbines and bio-energy systems. The scope of these systems includes small-scale PV systems suitable for rooftop installations, to larger-scale

systems that can feed into the grid. The size of the installation will depend on the installer- for example, a household will install a smaller unit than a mall, which will generally install a smaller system than an independent power producer (IPP). What is not specified in this discussion is the scale of RET systems that municipalities should consider, as this will depend on many factors not discussed here.

1.4. Research design, methodology and methods

Creswell (2009: 3) describes research design as the “the plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis”. Creswell (2009) advances three research design types as options for the researcher, namely qualitative, quantitative, and mixed methods design. The simplest way of differentiating between qualitative and quantitative designs being that the former primarily uses words to describe, while the latter primarily uses numbers. Mixed methods, therefore, are a combination of both methods, to the extent required by the researcher. The final choice of research design was itself guided by various factors, including: (a) the nature of the problem being addressed, (b) the envisaged ‘golden thread’ that is to hold together the ensuing discussion, and (c) the most ‘conducive’ approach for the author to coherently and concisely express their ideas and thoughts. A strong complexity theory influence permeates the author’s approach, requiring a three-fold exploration of context, components and ‘the system’ as a means of engaging with the research problem. The social nature of this research, placing it in policy contexts and therefore making it political (Clough & Nutbrown, 2003), lends it more to a discussion approach, and therefore a qualitative study.

In Chapter 3, the author purposefully adds personal reflections to the research method. Throughout the case study of Hessequa Municipality and the accompanying exploration of cases of RET implementation, personal reflections are used to tie up the author’s thoughts and the various themes that contribute to addressing the research problem. These were put in text boxes to enable the reader either to read separately or along with the main body of text. They were inserted as a means of pulling out common threads from all parts of the text body without disturbing the immediate flow of the discussion. These insertions, although highly subjective and personal, are considered significant for the study as they allow a glimpse into the author’s attempts to make sense of the information presented that may otherwise be veiled by the structures of academic writing.

1.5. Significance of this study

Buscher (2009) criticises the majority of academics involved in the South Africa energy debate for focusing only on either the policy landscape or on technical matters. Instead, he insists that “policy is part of a wider political, institutional process of action and more often than not follows or represents practice, rather than precedes or guides it” (Buscher 2009: 3953, citing Mosse, 2004). Therefore, according to Buscher (2009), a discussion of policies and technical mechanisms to support the implementation of RETs should follow a higher-level discussion of “the wider political-economic context in which this transition is taking place” (Buscher, 2009: 3953). This political-economic context is closely linked to what is commonly referred to as the South African minerals-energy-complex (MEC); a complex system of factors influencing decision-making at the highest levels of governance and, therefore, trickling down even to domestic perceptions of energy, and especially electricity use.

Buscher’s (2009) argument is herein acknowledged and, as becomes evident in the subsequent discussion, is supported by a holistic approach to understanding the factors inhibiting the widespread implementation of RETs in South Africa. The discussion attempts to factor in the larger context, in which the ‘municipal dilemma’ exists as a subset, through a complex-systems approach to understanding this larger South African context. It is however beyond the scope of this study to directly explore the political-economic context that so heavily influences government, and so this is identified as a limitation to this study.

Thus, in addition to employing a complex-systems approach to understanding the research context, this study makes a dedicated exploration of municipal management legislation, which was observed to be lacking in the literature discussing the country’s policy landscape, vis-à-vis renewable energy growth. Brent et al. (2012) suggested the importance of considering municipal management legislation; that municipal players are likely to act only if assured that they are acting within legislation and mandate. Thus, provision clearly made in legislations should, in essence, spur municipalities on in their efforts to address the municipal dilemma, and thus remove the often-cited perception of punitive and restrictive legislation and regulations. Numerous authors (Painuly, 2000; Philibert, 2006; Sebitosi & Pillay, 2008a, Sebitosi & Pillay, 2008b; Pegels, 2010; Krupa & Burch, 2011; Reinecke, Leonard, Kritzing, Bekker & Thilo, 2013) discuss the

barriers to the implementation of RET projects. However, very few were found to correlate these barriers, focused primarily on the national level, with barriers faced by the municipality. What this study motivates is that municipalities, by virtue of their strategic proximity to the citizenry and therefore their ability to observe the effects of strategy implementation, are best suited to spearhead a renewed effort to implement renewable energy generation projects. This position, coupled with the municipality oftentimes bearing the brunt of citizen dissatisfaction, adds impetus to the call for municipalities to revise their role.

This study is therefore relevant to several stakeholders:

- Academically, it contributes to the growing body of knowledge on the barriers to the widespread implementation of RETs, adding a new dimension to seeing municipalities as embedded within a complex political-economic context that Buscher (2009) refers to;
- Policymakers stand to be better informed on how to take advantage of municipalities' unique positioning close to the very citizenry that policy aims to serve.
- The final recommendations on developing appropriate policies, municipal capacity and renewable energy implementation strategies, are aimed at informing Hessequa Municipality's "Green Vision" (Hessequa Municipality, 2012) and hence the municipality's energy strategy.
- Ultimately, it is hoped that the findings and recommendations of this study will be applicable to South African municipalities in general.

This study has been organised in the form of two journal articles. The first article is a literature analysis of South Africa's policy landscape and the barriers to the widespread uptake of RETs in South Africa, with a specific focus on the energy and municipal management legislation. The second journal article is informed by an awareness of these barriers and policy opportunities. This latter article, having explored international and local cases of the successful implementation of RETs, identifies barriers to municipal implementation of RETs via a case study of Hessequa Municipality. Insights gained are presented as recommendations to assist Hessequa Municipality in its efforts to address the

municipal dilemma. However, the ultimate aim of this research is to assist all South African municipalities in addressing the municipal dilemma, and thereby contributing to national sustainable development and climate change mitigation efforts.

1.6. Limitations of the study

Though every study is inherently limited in its ability to gather all insights from a research problem, a researcher's obligation is to remain diligent in the research effort. Additional to this effort it is the researcher's obligation to identify major limitations to their work, both as a means of remaining humble, and as a learning process - highlighting gaps for further research and improvements. In light of this, the author notes the following limitations to this study:

- The thesis only contains a single case study, that of Hessequa Municipality, which limits the generalisation of insights - specifically insights common to South African municipalities. However, this limitation is somewhat mitigated by extensive research into several cases of RET implementation at local government level- both locally and internationally, as a means of supplementing and verifying the insights gained from Hessequa Municipality;
- The limited time and communication challenges with Hessequa Municipality prohibited the author from conducting a follow-up of the Nominal Group Technique exercise that was performed with staff members of Hessequa Municipality. The lack of further engagement with the participants greatly limited the author's ability to gain a deeper understanding of the views and opinions expressed by the participants of the exercise.
- The restricted opportunities available to interact with Hessequa Municipality also limited the specific relevance of this study to the municipality's development plans, and much of this discussion is based on insights gained from an initial two-week visit to the municipality in October 2012 and from documents that are publicly available. What has resulted, instead, are more generic recommendations in the second journal article (Chapter 3), guided by limited interactions and Hessequa Municipality's Green Vision.
- The literature analysis of South Africa's policy landscape was limited as to the amount of legislation that it could include, as a result of both limited time to

conduct the analysis and the dynamic nature of the policy landscape, with policies constantly being revised and updated.

Chapter 2: Journal article 1

2. *A literature analysis of the barriers to and opportunities for renewable energy technologies at the municipal level*

2.1. Introduction

South Africa has a unique history with regard to energy and especially electricity. The apartheid era and the international sanctions that came with it forced the country to invest heavily in coal-fired generation to ensure security of energy supply. Powerful companies such as Sasol and Eskom emerged during this age, investing heavily in coal technology for both fuel and chemicals production as well as electricity production, thus entrenching the country's dependence on coal. Reiterating this same notion, Skeen & Spencer (2012: 77) note that:

“South Africa faces a number of broader regulatory challenges that hinder the adoption of clean energy systems. Many of these extend from the market dominance of Eskom and Sasol in the South African energy sector, and the technological lock-in effects that go hand-in-hand with an energy system that is heavily reliant on a single source of energy”

Two decades on from the end of apartheid, and the South African economy is only beginning to be exposed to the *real* price of electricity. This situation, in the midst of the 21st century's greatest challenge, namely that of climate change and the call for sustainable development, has culminated in what is herein referred to as ‘the municipal dilemma’.

2.1.1. The municipal dilemma

The municipal dilemma refers to the nexus between: (a) municipal mandates to provide basic services; (b) the possible financial risks of implementing renewable energy technologies (RETs); (c) the regulatory ambiguity surrounding electricity generation and distribution jurisdiction; (d) the necessary engagement, by municipalities, with RETs as a means of addressing the growing risk of revenue loss from reduced electricity sales as consumers install their own RETs, and (e) as a contribution to national climate change mitigation efforts. The age old curse of the South African minerals-energy-complex

(MEC) which sees powerful forces, deeply vested in the country's coal and minerals dependence, influencing government action, is the context within which the municipal dilemma is embedded. By embedding the problem statement within a larger context, it is recognised that the municipal dilemma is influenced by, and influences other parts of the South African context. This has prompted the adoption of a complex systems approach to engaging with the research problem. This is elaborated on further in the discussion, with a brief attempt to describe the system and how the municipality and the municipal dilemma fit into it.

2.1.2. Aims and objectives of this study

Janisch, Euston-Brown & Borchers (2012) explore the effects of energy-efficient measures and distributed generation, via renewable energy generation, on municipal revenue. Their findings indicate that these technologies, unaddressed by the municipality, pose potentially significant threats to municipal revenue. Thus, this study aims to assist municipalities in addressing the threat of revenue loss in the municipal dilemma. In addressing this dilemma, it is therefore crucial to remain cognizant of the messy web of politics and history that comes with 'the South African' context, and also of the non-linear cause-and-effect relationships characteristic of a complex, social system.

The objectives of this study - a literature analysis of the barriers to and the opportunities for the widespread growth of RETs at the municipal level - taking on a complex systems theory approach, are therefore to:

- Determine the major barriers to the general implementation of RETs in South Africa.
- Identify energy and municipal management legislation conducive to the implementation of renewable energy technologies by municipalities.

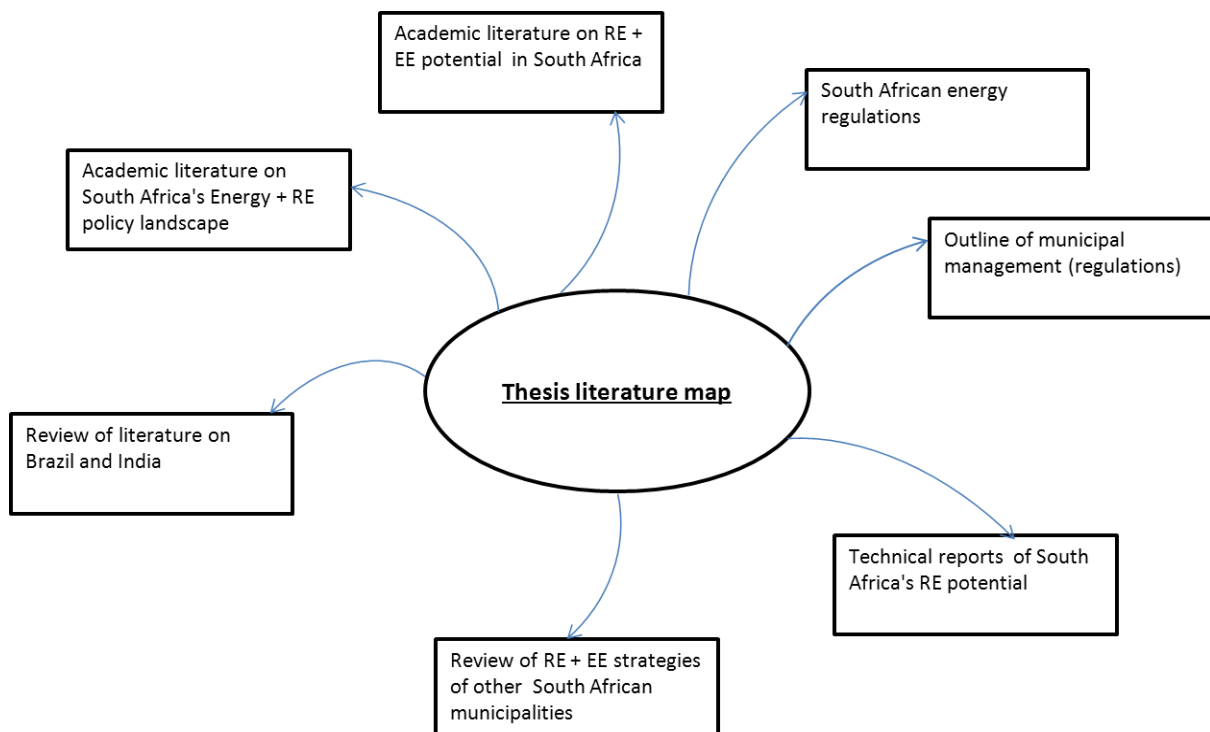
The barriers to the implementation of RETs that are discussed are general barriers, which will also apply to the municipal level. Though the municipality itself will face more specific barriers, these general barriers require addressing before any major progress can be made, and as will be discussed, the municipal is proposed as a vehicle for a new means to addressing these barriers.

2.1.3. The literature review

The literature review as a methodology takes various forms. Jesson, Matheson & Lacey (2012) advance two main types of literature reviews present in current research methods, namely: traditional and systematic. Listed with traditional literature reviews are: (a) conceptual reviews; (b) state-of-the-art reviews; (c) expert reviews; and (d) scoping reviews, while the systematic review stands alone. The traditional review is described as flexible, allowing the researcher to explore ideas, while also being prone to subjectivity on the part of the author (Jesson et al., 2012). The systematic review, however, leans more towards the scientific method, with “a clear stated purpose, a question, a defined search approach, stating inclusion and exclusion criteria, producing a qualitative appraisal of articles” (Jesson et al., 2012: 12).

Having developed the research problem, a tentative literature map, or rather a thematic map was produced to guide this study’s literature search as depicted in Figure 2-1 below. The initial approach was to take on a systematic approach in gathering literature in the various subtopics depicted on the map, and then begin to piece together the argument.

Figure 2-1: Literature/ thematic map



However, Clough & Nutbrown (2003: 25) speak of the notion of “radical looking”, in which the researcher explores the research topic beyond the familiar, moving out of a rigid programme and becoming open to new findings and even counter-arguments.

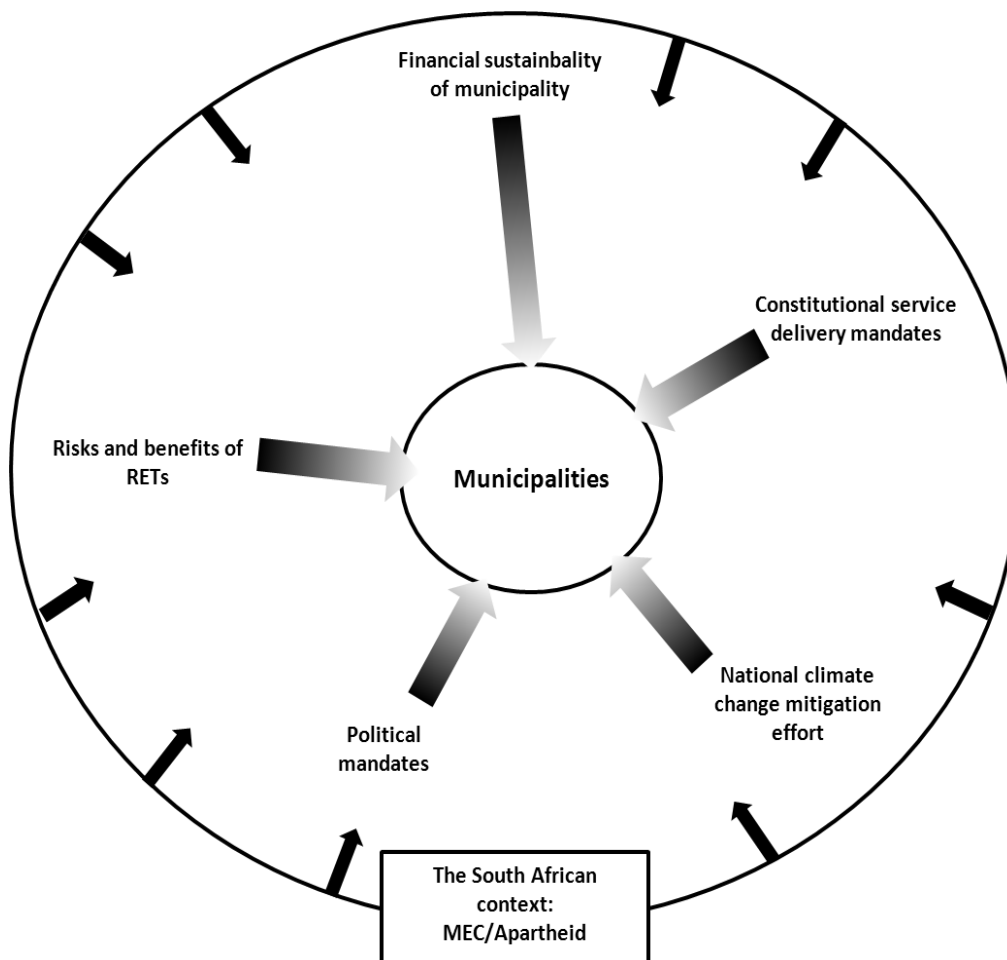
Having started with the list of reference material from the author's Post Graduate Diploma (PGD) programme, radical looking led to online and library database searches on topics as varied as understanding policy (Education and Training Unit (ETU), n.d.), using systems thinking for knowledge management (Rubenstein-Montano et al., 2001), complex systems theory (Kast & Rosenzweig, 1972; Lilienfeld, 1975; Cilliers, 2000; Rubenstein-Montano et al., 2001; Geyer, 2003), and the political economies of energy in South Africa (Buscher, 2009). The ultimate result of such an exercise was to enable a better understanding of the context of the research problem, and therefore of the problem itself. Thus, the literature review ultimately took on a more traditional approach.

The literature map in Figure 2-1 was itself influenced by the author's prior understanding of the research topic, hence branches such as 'Academic literature on South Africa's energy and RE policy landscape'. Branches such as 'Review of literature on Brazil and India', were specifically developed with the aim of gathering lessons from countries economically similar to South Africa- hence the choice of South Africa's fellow BRICS member states. What is also evident is that as the 'radical looking' process continued branches such as 'Technical reports of SA's RE potential' took on less significance, while other that include complex systems theory, were developed extensively. Thus, this initial literature map was the author's attempt to map out the first initial thoughts and ideas of possible topics to be included in the discussion.

2.2. A complex systems approach to understanding the municipal dilemma

The municipality, being the lowest leg of the three-tiered structure of national, provincial and local governance of the South African administration is subject to: (a) the decisions of the two higher tiers and the politics therein; (b) the demands of its citizenry; and (c) its constitutional service delivery mandates. This places the municipality amidst a plethora of often contradictory forces. The provision of basic services to its citizens may, for example, often compete with the demands of more national government driven programmes. Sebitosi & Pillay (2008b: 3315) refer to the “web of bureaucratic barriers” inhibiting the growth of RETs. This same web is the plethora of contradicting forces previously mentioned, and is a result of the municipality operating within a larger context, herein considered as a complex system. As a result of this context and the dynamics anticipated, it was deemed appropriate and useful to take a complex systems approach- elaborated on in section 2.2.2, to engaging with the research problem. An attempt to depict the municipal dilemma in its context is made in Figure 2-2 below.

Figure 2-2: Pictorial representation of the municipal dilemma



It must be noted that the representation in Figure 2.2 is by no means complete, rather it is an attempt to depict the multitude of factors which impact upon the municipality. What is not depicted here is the influence of the municipality on its surroundings. As elaborated in section 2.2.2, components of a complex system influence each other, and hence the system as a whole, and then the system's environment. Rubenstein-Montano et al. (2001: 6) note that "systems thinking examines relationships between the various parts of the system", setting a fitting background to the research effort. Cilliers (2000: 23), however, discourages any attempts to use complex systems theory to control organisations, noting that "any hope that a study of complex systems will uncover the way to running an organisation is in vain". Thus, this exploration of complex systems theory is rather a measure to enable a better understanding of the research problem. Geyer (2003: 23) reiterates this same sentiment, noting that it is only once

"...one abandons the arrogance of order and disorder and accepts the humbling limits of knowledge and uncertain potential which complexity implies then a new politics emerges: a politics of uncertainty, but also of openness, of mistakes and learning, of failure and adaptation"

Thus, in this research effort, the use of complex system theory and systems thinking affords a unique perspective into the research problem, especially with regards relationships between the municipality, the advent of RETs, national policies and regulations, ultimately the 'municipal dilemma'. What is called for, however, through this cautionary statement by Geyer (2003) is an acknowledgment of the limitations of complex systems theory and awareness, therefore, that other means of research are still required. A complex systems approach in itself, is not complete and can never provide full understand, but is a tool to be used in conjunction with others.

2.2.1. A complex history

Complexity theory has had an ever-evolving history, rooted in general systems theory (GST), which was advanced by Von Bertalanffy in the 1930s (as cited in Rotmans & Loorbach, 2010). General systems theory itself was born of analytical endeavours in fields such as cybernetics and control engineering. It then evolved to systems dynamics and then into integrated systems theory, which began to break away from a heavy analytical approach, and to attempts to "integrate physical, economic, socio-cultural and sometimes financial systems" (Rotmans & Loorbach, 2010: 115). Additionally, Clayton

& Radcliffe (1996: 17) indicate that GST was “developed, in response to this perceived need, to provide a unifying analytical and explanatory framework throughout the hierarchy of nature”. Ultimately, complex systems theory moves beyond the reductionism of the scientific method and places as much emphasis on “identifying and describing the connections between objects and events as on identifying and describing the objects and events themselves” (Clayton & Radcliffe, 1996: 18). Although complex systems theory openly embraces uncertainty and goes so far as to encourage expectation of the unknown - embodied in notions of emergence - this in no way justifies abandoning the due diligence required of thorough research (Cilliers, 2000).

2.2.2. Characteristics of a complex system

Numerous authors such as Kast & Rosenzweig (1972), Lilienfeld (1975), Cilliers (2000) and Rotmans & Loorbach (2010), provide descriptions of common characteristics of a complex system. These characteristics have been used to better understand the complex system - namely the South African context - in which the research problem is found. Cilliers (2000) summarises these characteristics as follows:

- Complex systems consist of a large number of elements.
- These elements are constantly interacting in rich, dynamic, non-linear interactions with those components closest to them.
- These interactions, propagating throughout the systems result in both positive and negative, direct and indirect feedback loops which determine the system's behaviour.
- Complex systems are open to their environment, constantly sharing and receiving energy and information, and therefore operate away from equilibrium.
- Complex systems, through their experiences have a history which is essential to their behaviour, and is found throughout the whole system.
- The behaviour of complex systems is dependent on the multiple, non-linear interactions between its components, and these interactions give rise to ‘emergent’ properties.
- Complex systems, open to their environment and dynamically interacting within themselves, are adaptive and able to reorganise themselves, as a response to external or internal stimuli.

On the point of emergent properties, Cilliers (2000: 24) notes that the “presence of emergent properties does not provide an argument against causality, only against deterministic forms of prediction”, but is rather the manifestation of “novel and coherent structures, patterns, and properties during the process of self-organization in complex systems” (Rotmans & Loorbach, 2010: 119). Rubenstein-Montano et al. (2001: 6) indicate that these emergent properties of complex systems “do not exist when systems are decoupled into smaller parts”, thereby encouraging a holistic approach to systems.

Rubenstein-Montano et al. (2001: 7) emphasise that “[a]daptive systems change in response to changes in the system to better achieve the goal(s) or purpose of the system”. A simplistic translation of this idea applied to the municipal dilemma is that the ‘system’- i.e., the larger, South African context, can and will change in response to concerted municipal efforts to engage with, and implement, RETs. Considering the various influences depicted in Figure 2-2, and that RETs can contribute to addressing the municipal dilemma, this simplistic idea seems increasingly attractive and sensible. Thus, the notion of complex systems theory forms the backdrop of the ensuing discussion, especially the idea of relationships and influence between components within such a systems.

2.2.3. The role of relationships within a complex system

Cilliers (2000) notes that relationships are fundamental to understanding complex systems and that these systems are best understood in their contexts. The elements of the complex system at hand, herein referred to as the ‘South African context’, include, but are not limited to: (a) government interests in the minerals and energy industries, which influence long-term decisions regarding the country’s energy economy, which then trickle down to decisions regarding energy use and planning - especially electricity; (b) traditions rooted in coal dependency, both on the part of government and South African energy consumers; and (c) ramifications of the apartheid era in the form of disparities in the society where the majority of the voting population looks to the government to deliver on the short- to mid-term basis, which then hinders a concerted focus on long-term development.

Only by taking cognizance of the relationships between these elements can a better understanding of how to address such barriers be gained. Reiterating this same notion, Rubenstein-Montano et al. (2001: 10) assert that it is within “the concept of emergent

properties of systems where knowledge is learned and/or unlearned ... when relationships in the systems are evaluated and understood”. A detailed description of these actors and how they interact is not within the scope of this research; however, throughout the rest of the discussion the implications of such relationships on the larger system will remain as a guiding light.

Rotmans & Loorbach (2010: 125) provide a counter-argument to the use of complex systems theory in addressing real social issues, asserting that “complex systems theory usually focuses on many homogenous agents with relatively simple behaviour, with hardly any real-world application at the level of social systems”. At this point it is important to recall Geyer’s (2003) cautionary note on the limitations of complex systems theory and its use. What is aimed for here, through complex systems theory, is an increased appreciation of the dynamics involved in the municipal dilemma. Considering the municipal dilemma as situated within a complex system already bares many parallels to the characteristics of a complex system- with relationships being seen between the municipal and other tiers of government, with the system having a history and with their being learning and thereby adaptation within the system. Thus, while no concerted effort is to be made to map out the various components of this complex system and their relationships, this backdrop is deemed useful in shedding further light on the problem statement. Thus, the use of complex systems theory is deemed useful to better understand, at the very least, the context of the research problem and brings the research a step closer to assisting municipalities to address this challenge.

2.3. Outline of South Africa's energy policies

Prior to a discussion on barriers to RETs, and especially those specific to the South African context, an overview of the existing legislation concerning energy and municipal management is necessary. The focus, especially on municipal management legislation, stems from both (a) the aims of this study, to address specifically the municipal dilemma, and (b) an observed lack of inclusion of municipal management legislation in the South African energy debate; this despite electricity provision being a municipal mandate. In addition, since this legislation forms part of the relationship between municipalities and other components of the South African context, a basic knowledge of the main pieces of legislation and their implications for the municipality is required.

South Africa's participation in the RE space is still in its beginning phases, with the launch of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in early 2011 (EcoMetrix, 2012), and the announcement of the successful bidders in the 3rd bidding window in the latter part of 2013. The rapid launch of this huge renewable energy undertaking closely follows massive power cuts throughout the country in 2007/2008 and capacity constraints since. This crisis, coupled with growing international pressure on South Africa- as a signatory to the Kyoto Protocol and a member of the UNFCCC and the 12th most carbon intense economy worldwide (EcoMetrix, 2012), set the scene for a move towards renewable energy. The allocated generation capacity for RE, 3.725GW, will account for less than 10% of South Africa's total generation capacity.

The South African energy crisis has several facets, including the national front where the economy is deeply affected by power cuts and capacity constraints and the domestic level where increasing electricity prices are increasingly weighing down on the household. What is called for, is a complimentary effort to national government's RE effort, spearheaded by the municipality- which is positioned close to citizenry and therefore acutely aware of the challenges faced by consumers- to further accelerate the implementation of RETs. Discussed in section 2.5, are the barriers to the implementation of RETs. Having considered these, the municipality is proposed as suitable to lead a renewed, alternative "bottom-up" effort to grow RETs. Such an approach would see municipalities (a) seeking clarity on regulations, (b) writing by-laws conducive to the

implementation of RETs, and (c) proactively engaging with national government to facilitate municipal adoption of renewable energy generation.

This same call for an alternative approach is reflected in the National Energy Regulator of South Africa's (NERSA) drafting of the *Standard Conditions for Embedded Generation within Municipal Boundaries for small scale (less than 100kW)* (2011) which effectively places “regulation and control of grid connection of rooftop solar PV systems . . . within the municipal area of competence” (EE Publishers, 2012). The municipality, forming part of the larger South African context, can work to provide an internal stimulus for the system to reorganise itself for its own survival - in this case to achieve sustainable development, a large part of which involves the implementation of RETs.

The next section seeks to provide a basic overview of South Africa's policy landscape, from an ‘opportunities’ perspective, thereby strengthening the case for RETs.

2.3.1. The legal jargon

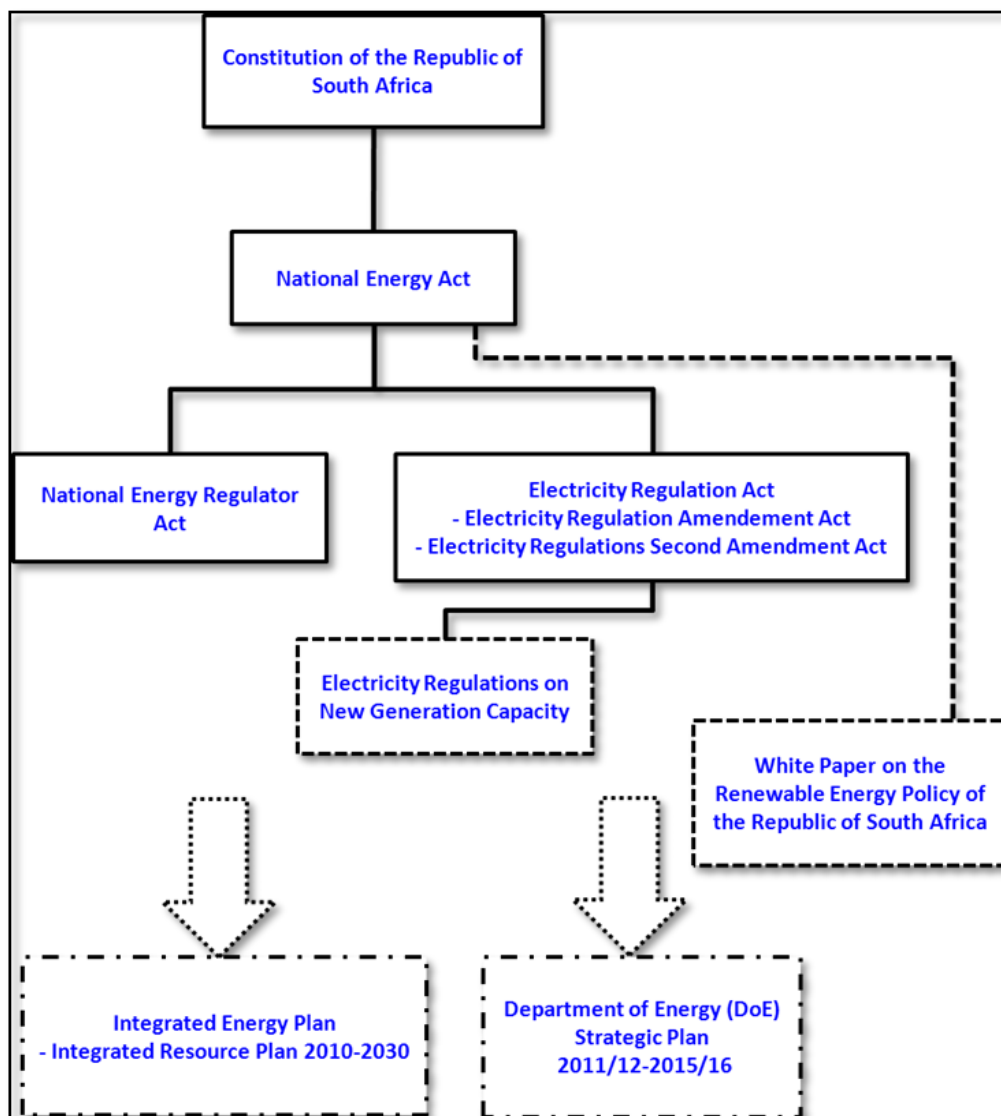
Before discussing the country's energy legislation, a basic summary is provided of the legal terminology involved, especially the differences between acts, policies and regulations. The Education and Training Unit (ETU, n.d.) explains that a policy is a document *outlining* what a ministry seeks to achieve and the methods it will use to realise this goal. A policy document is thus not a law, but may identify the need for new laws; or the amending of existing laws to achieve its objectives. Once a policy undergoes a rigorous process of public comment and alignment with existing Acts and the Constitution, the President signs it off and it becomes an Act which is identified as obligatory in law.

Once a law has been passed, it is subject to amendments in light of current national and global developments. Ministerial strategic plans such as the Department of Energy's (DoE) Strategic Plan 2011/12-2015/16 (DoE, 2012) and the Integrated Resource Plan (IRP) 2010 – 2030 (DoE, 2011) are informed by these Acts, or rather, have been developed to implement the objects of these Acts. Delays and areas of conflict in this continuous, and often slow process of law-making, enforcing and revision contribute to the “web of bureaucratic barriers that frustrate prospective investors”, project developers and even members of government themselves (Sebitosi & Pillay, 2008b: 3315).

Figure 2-3 below depicts the network of policies and regulations guiding South Africa's energy use. It must be noted that this figure is neither complete nor completely accurate, but is used as a basis from which to engage with the regulatory maze surrounding energy and more specifically renewable energy-generated electricity. It is worth noting that legislation is also one of the components of the South African context, at once influencing the behaviour of the system and also subject to influence from the system.

It is hoped that by understanding the legislation landscape and process in its context (as sketched in Figure 2-3), more light may be shed on the municipal dilemma and the means to address it.

Figure 2-3: Diagrammatic representation of key South African energy regulations and policy



2.3.2. South Africa's energy legislation -- mandated opportunities

As depicted in Figure 2-3, the Constitution (Republic of South Africa, 1996) is the overarching document guiding all other Acts and policies adopted by the government. The Bill of Rights, in Section 24 of the Constitution, states that all citizens have the right to an environment protected from pollution and harmful exploitation for present and future generations. It can, and must therefore, be expected that all policies adopted by government, including and especially those with far-reaching environmental impacts such as energy regulations, will be guided by this right. The Constitution also informs the National Energy Act 34 of 2008b (Republic of South Africa, 2008b), which promotes the use of renewable energy to diversify the country's energy supply and contribute to sustainable development. The Act provides guidance for integrated planning for demand and supply management to ensure that all stakeholders in various sectors of government and society are informed about these integrated plans and strategies. This implies that the municipality can significantly contribute to the development of these plans and strategies, as municipalities have access to on-the-ground insights pertaining to the successes and failures of these programmes. Similar to a complex system always operating far from equilibrium, the country can constantly learn from the insights gained by municipalities.

The National Energy Regulator Act 40 of 2004 (Republic of South Africa, 2004) established the National Energy Regulator (NER) - now commonly referred to as NERSA - whose duty it is to regulate the piped-gas, petroleum and electricity industries of South Africa. It is NERSA's responsibility to work with municipalities in their efforts to implement RETs. Given that a 'bottom-up' approach is advocated, the responsibilities of NERSA could potentially be limited to the strategic overseeing the renewable energy generation sector, while more local bodies are mandated with the implementation and running of these programmes. In this scenario, municipalities are yet again best suited to take a lead in setting up and running these localised, co-ordinated efforts. The objectives of the Electricity Regulation Act 4 of 2006 (Republic of South Africa, 2006) are to (a) facilitate investments in the electricity industry and (b) to promote diversification of energy sources. This Act has been twice amended, firstly to include a section detailing electricity reticulation by municipalities (Republic of South Africa, 2007) and four years later, an Electricity Regulation Second Amendment Bill (Republic of South Africa, 2011: 2(e)) was produced to include the promotion of "renewable sources of energy and energy efficiency" and to give direction for new generation capacity. It is interesting to note the

period between the first and second amendments in the light of the electricity shortages experienced in 2008. It would seem that the second amendment signals the government's recognition of the need for investments to increase electricity generation capacity; however, more interesting to this study, is the inclusion of the role of renewable energy in this recognition.

The Department of Minerals and Energy's White Paper on Renewable Energy (Department of Minerals and Energy (DME), 2003) is the most elaborate of the documents reviewed, vis-à-vis the government's vision on renewable energy. The document states that it is "intended to give much needed thrust to renewable energy" (DME, 2003: i). This direction was manifested in a target of 10,000GWh renewable energy contribution to final energy consumption by 2013 (DME, 2003; DoE, 2011). This White Paper also states that it is based on the integrated resource planning criterion of,

"[e]nsuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options" (DME, 2003: vii).

However, despite this White Paper being produced a decade ago and recognising the potential of RETs in comparison to conventional technologies, it was only after the 2007/2008 electricity shortages that the government made significant moves to facilitate the growth of RETs through the impressive REIPPPP. This delayed action on the part of the government is more evidence of the problems within the South African context in which vested interests and over-politicization of the energy sector (Pegels, 2010; Krupa & Burch, 2011) hinder the system's ability to react to stimuli. At the same time however, this rapid turn around and huge RE undertaking is a sign of changes within the system.

Naturally, the *Integrated Resource Plan 2010 – 2030* (DoE, 2011a) refers, for guidance, to the White Paper on Renewable Energy, among other documents, in its attempt to explore the use of a variety of energy source options to meet South Africa's projected energy demand. The Department of Energy's (DoE) (2010) *Strategic Plan 2011/12 – 2015/16* encompasses the department's strategies to use all available energy resources to meet future demand while achieving government mandates of universal electrification and affordable services. As part of its strategic objectives, it also has,

“[e]fficient and diverse energy mix for universal access within a transformed energy sector”

and,

“[e]nvironmental assets and natural resources protected and continually enhanced by cleaner technologies” (DoE, 2010: 20)

Again, what is alluded to, without absolute certainty however, is the notion of transforming the energy sector to incorporate a larger portfolio of renewable and sustainable energy sources.

What becomes evident from this brief overview of key energy-related legislation is that renewable energy is abundantly catered for and supported. From the Constitution to strategic plans for energy use, renewable energy has a role - if not an increasingly significant one. Krupa & Burch (2011: 6259) recognise renewable energy’s potential to address marginalization; born of South Africa’s apartheid era, and the “environmental degradation concerns [associated] with coal-based power production”. South Africa’s global ranking as the 12th highest CO₂ emitter globally (DoT, 2010), places the onus on government, and indeed the country at large, to actively participate in the global climate change mitigation effort.

The country’s renewable energy potential is neither insignificant nor concentrated in one particular resource, strengthening the case *for* renewable energy. Table 2-1 below presents only some of this potential. It is worth noting that South Africa’s role as a major player in the energy sector of the Southern Africa Development Community (SADC) region, and in Africa (in which Eskom supplies an estimated 45% of electricity (Eskom, 2013)), opens up more opportunities for increased renewable energy harnessing. Co-operation with other countries in the region; the most notable case being the mega-hydro project envisaged on the Zambesi and Congo rivers- estimated to hold a potential 100,000MW of generation capacity (Eskom Holdings, 2010)- has the potential to vastly change South Africa’s energy mix.

Legislation is found to be conducive to RETs and their widespread use and is coupled with a highly viable renewable energy resource, yet one looks at the system and notes a disproportionate reaction in the way South Africa is taking advantage of these abundant resources- namely renewable energy resources. However, there is hope in that the scene

is set for change, where another stimulus - be it a new piece of legislation or a critical mass of municipal RET undertakings - will propel the system into drastically reorganising itself and result in the widespread use of RETs. Programmes such as the REIPPPP are evidence of the gradual response to both internal and external stimuli. The generation capacity portfolio allocated to RETs, though significant for any single programme, will supply less than 4GW of the country's more than 44GW capacity (Eskom, 2012), indicating that the system requires more prodding, and municipalities have a significant role to play in this. What is evident throughout the section above, is that legislation not only provides for the adoption of RETs, but mandates their implementation. Thus the opportunity for the country to adopt RETs - a process in which the South African municipality is an essential element - is essentially mandated by existing legislation.

Table 2-1: Summary of South Africa's renewable energy potential

Technology	Total capacity available
Wind power	- Considering only 1% of land identified as suitable, an estimate of 50GW -producing 106TWh at capacity factors between 24% - 37%
Biomass	Bagasse: - Potential for 1.4MWh per annum Energy crops: - Estimate of 2001 energy production from residues- 342GJ/year Manure and litter from animals: - 6.5MWh/year (1996 source) - 41.6TWh of heat energy and 16.4TWh of electricity generation
Hydro power	- Theoretical potential estimated as: 8.36GW, or 73TWh/year - Scenario explored resulted in upper limit of 5.5GW (producing 14.6TWh) at an average capacity factor of 30%
Solar power	Average daily radiation levels of: - 4.5 – 6.5kWh/m ² (16 – 23MJ/m ²) Solar thermal potential: - SA has potential for 64.6GW assuming the use of only 1% of viable area - The potential of PV and Solar thermal technologies are not limited by resource availability, but rather by global and local industry
*Wave power	Total average capacity available along SA coast: - 56.8GW -Potential of 18GW using 75% of viable coastline *This energy-type faces major constraints in terms of technology maturity

Adapted from Tshehla (2012) (Sources: DME, 2002; Banks & Schäffler, 2006)

2.4. Outline of South Africa's municipal management policies

The lack of consideration of municipal management legislation, especially around energy, in the South African energy debate is hereby addressed. More so the role of the municipality in influencing the larger system- of which it is a component- and addressing the municipal dilemma. Thus, the following exploration of municipal management legislation seeks opportunities for municipalities to actively engage with RETs- if at the least, as a means of addressing the municipal dilemma. Furthermore, insights into the actual provisions of legislation, versus perceptions of what legislation implies, are important in assisting municipalities to become more bold in their approach to legislation and in undertaking the projects that will be necessary going forward.

2.4.1. Visualising the structure of municipal management legislation

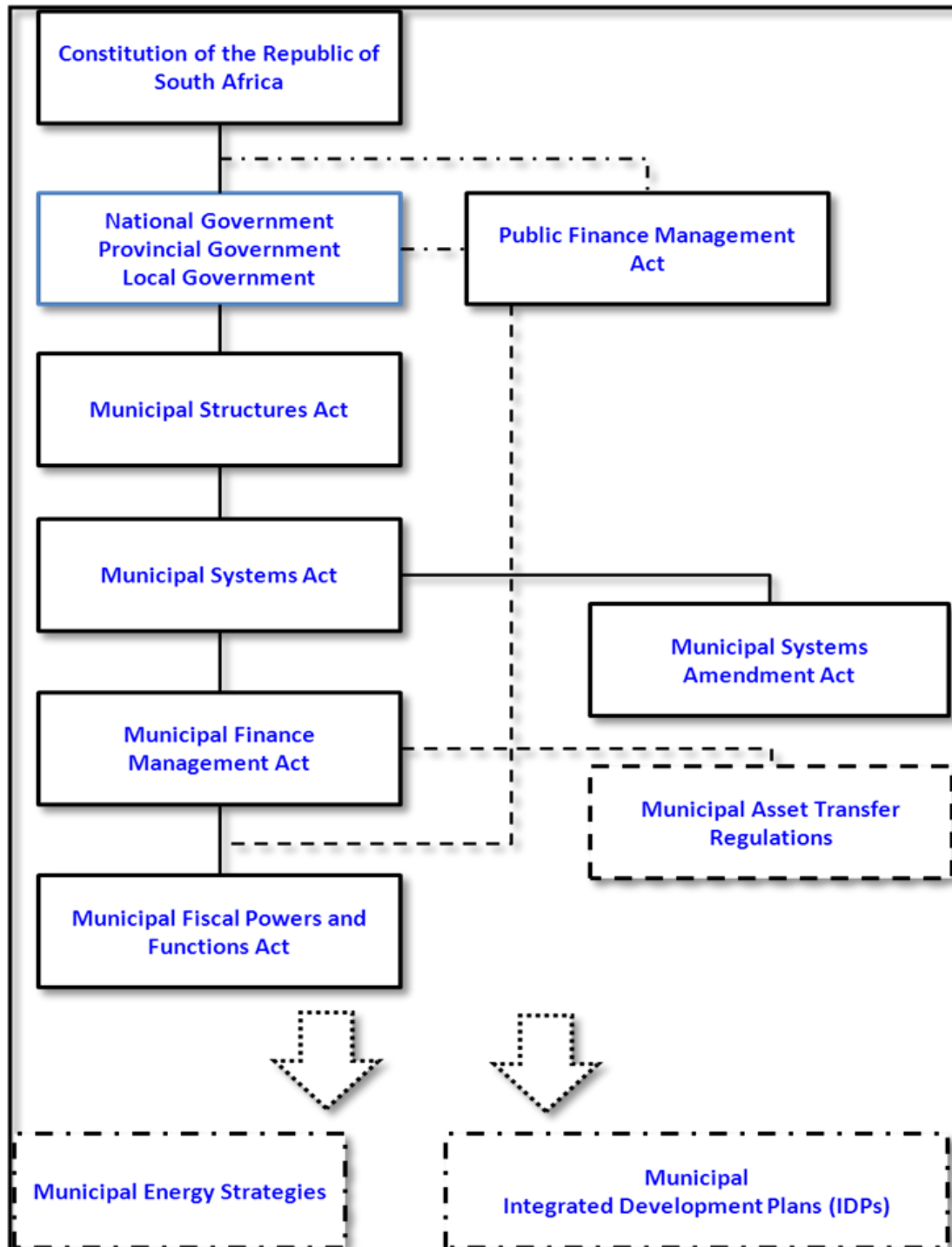
As with the previous section 2.3, this section seeks to grasp the network of legislation governing the management of municipalities by a depiction of the network of key Acts affecting local government and therefore municipalities (see Figure 2-4).

As mentioned in section 2.2, municipalities are part of the 3rd tier of South Africa's governance system of national, provincial and local government; each with decreasing legislative authority, respectively. Thus, municipalities are influenced by legislation from the two tiers of government above them, yet also have their own, constitutionally allotted, legislative authority. This means that for municipalities to engage in any 'extraordinary' projects, such as the implementation of renewable energy generation projects, a rather complex flow of legislation must successfully occur. In addition to these requirements, are: (a) the requisite political will; (b) financial capacity of the municipality; and (c) stakeholder support for municipal actions – in other words the municipal dilemma. An understanding of the interactions between political will and the demands and needs of the citizenry opens up vast opportunities for a different approach to achieving sustainable development in South Africa, spearheaded by municipalities.

A perusal of the various pieces of legislation organised into Figure 2-4, will show provisions conducive for the implementation of renewable energy by municipalities. What is worth noting is that the commonly cited challenges of a lack of human and/or financial capacity, and the general perception of legislation as stifling - particularly municipal finance management legislation – are addressed within legislation, requiring

only a braver, more pro-active effort by the municipality. In the following overview (section 2.4.2) those two provisions are highlighted.

Figure 2-4: Diagrammatic representation of key South African municipal regulations and policy



2.4.2. Unwrapping municipal management legislation

As with the legislation guiding energy, the Constitution provides the overarching mandates to municipal structuring and management. Section 152 of the Constitution states that “[t]he objects of local government are – to ensure the provision of services to communities in a sustainable manner” (Republic of South Africa, 1996: 152(b)). This mandate is to be fulfilled within the financial capacity of the municipality, while national and provincial government are mandated to “support and strengthen the capacity of municipalities. . . to perform their functions” (Republic of South Africa, 2006: 154). Numerous sections of the Constitution allow the municipality to exercise its right and mandate to provide services, taking into account relevant national and provincial legislation.

The *Local Government: Municipal Structures Act 117 of 1998* provides for the establishment of municipalities, guided by the constitutional mandate of municipalities to ensure “sustainable, effective and efficient municipal services, promote[ing] social and economic development, encourage[ing] a safe and healthy environment” (Republic of South Africa, 1998). This Act also informs the *Local Government: Municipal Systems Act 32 of 2000* (Republic of South Africa, 2000) which provides the operational principles of municipalities. Chapter 2 of the latter directs national and provincial government to exercise their powers in a manner that does not compromise or impede on the municipality’s own objectives and authority. In the case that there is uncertainty as to which institution has authority over a given issue, provision is made for clarification - often resulting in the creation of guiding legislation, informed by the Constitution. Chapter 8 provides guidelines for the provision of municipal services where provisions are made for municipalities to employ either internal or external entities to deliver these services. The *Local Government: Municipal Systems Amendment Act 44 of 2003* (Republic of South Africa, 2003) amends Chapter 8 of the main Act, to include national and provincial organs of state as options for municipalities to employ in their provision of municipal services. In light of renewable energy generation implementation, entities such as Energy Service Companies (ESCOs) are catered for by legislation. Their establishment or engagement offers various opportunities for municipalities to use other technical and human resources that municipalities may or may not have within themselves.

Finance plays a large part in determining the success of projects, especially at the municipal level where three-year budget cycles often hinder the long-term investments required for many renewable energy projects. This need for long-term engagement is especially the case with technologies in the early stages of their learning curves (the concept of learning curves is discussed further in section 2.5.1 and reveals more opportunities for RETs.) However, the *Local Government: Municipal Finance Management Act (MFMA) 56 of 2003* (Republic of South Africa, 2003) makes provision for contracts which impose future budgetary obligations on municipalities or municipal entities. This then is contrary to the MFMA's infamous reputation as punitive and restrictive.

Furthermore, Chapter 6 of the MFMA of 2003 states that municipalities may incur long-term debt (explained as debt payable over a period longer than one year) for "capital expenditure on property, plant or equipment to be used for the purpose of achieving the objects of local government" (Republic of South Africa, 2003: 46(1)(a)). Sections 48 and 50 outline the procedure and conditions under which a municipality may issue fiscal guarantees for external and internal undertakings – which is a further indication of an environment conducive to the use of public-private partnerships (PPPs) for municipal service delivery. In fact, section 120 provides for municipalities entering into PPPs, given that the municipality has demonstrated the benefit of the PPP over all other available options. However, reference to the *Municipal Systems Act 32 of 2000* (Republic of South Africa, 2000) and to Chapter 5 of the MFMA reveals that the use of municipal entities - considered to be internal rather than external entities - is simpler. Wrapped in *less* regulatory-tape, especially with regard to the incurring of long-term debt and therefore financing, municipal entities seem to offer an easier route to facilitate the implementation of municipal renewable energy projects. Ultimately, whether an internal or external entity is employed to pursue renewable energy projects, there is adequate provision made for either path.

The other pieces of legislation and strategies depicted in Figure 2-4 provide further guidance on the operation of municipalities. The obligation on municipalities to produce Integrated Development Plans (IDPs) and regularly revise them may be seen as cumbersome; however, it is also an opportunity for the municipality to transfer its learning into the larger system. From a complex systems perspective, the municipality-strategically positioned closed to the citizenry- has the potential to act as a conduit for

information and experience about the benefits and appropriate means of implementing RETs, through processes such as the yearly revision of the IDP. As the cost of RETs continues to drop as installed capacity, both in South Africa and globally, increases and through further research and development (R&D) efforts it becomes easier for more smaller-scale projects to be implemented, and therefore for more learning- enter the municipality.

The above discussion of energy and municipal management legislation makes the case for action. Not only is there legislation which facilitates engaging with RETs, the same legislation *mandates* the use of RETs. Within the same web of bureaucracy are opportunities to effect a significant change within the system, namely the South African context. Given that legislation is seemingly supportive, it is necessary to then explore the barriers inhibiting the implementation of renewable energy generation.

2.5. Barriers to the implementation of Renewable Energy Technologies

Having highlighted the numerous opportunities present in legislation for the implementation of RETs, this section seeks to describe the barriers to the widespread use of RETs. Generic barriers will first be explored, followed by more South African-specific barriers.

Painuly (2000) describes barriers to renewable energy as consisting of: (a) cost effectiveness; (b) market barriers; (c) institutional, political and regulatory barriers; (d) social and environmental barriers; and (e) technical barriers. Philibert (2006) further groups these barriers into three categories, namely: (a) economic, (b) institutional and behavioural, and (c) technical barriers. Painuly (2000) asserts that the classification of barriers into different categories does not make them mutually exclusive, and that some barriers are relevant across several categories. Reminiscent of feedback loops, Painuly (2000: 81) states that barriers can even have “cause-effect relationships”, within and between categories. Thus, placing barriers within the larger system, namely the South African context, allows a better understanding of the causes of, and interactions between, these barriers and possible means of addressing them.

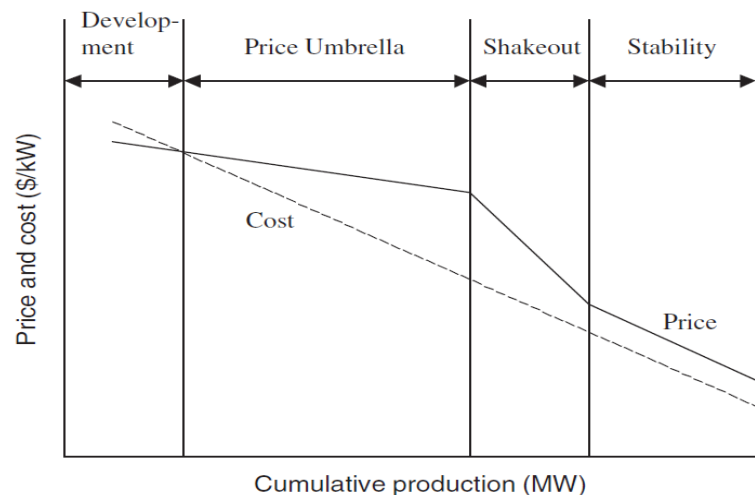
2.5.1. Economic barriers

Economic barriers, which include (a) limited market sizes; (b) high discount rates; and (c) non-consideration of externalities (Painuly, 2000), cause market distortions which hinder the development of RETs by making these technologies appear less price-competitive than conventional technologies. Philibert (2006: 18) indicates that “direct or indirect subsidies to other energy sources” often contributes to the unfavourable price competitiveness of conventional energy technologies over RETs. In the case of South Africa, this is obviously applicable to coal-fired electricity. Added to this is what Philibert (2006: 17) refers to as “the frequent lack of internalisation of environmental externalities, notably air pollution and climate change in fossil fuel prices”. As mentioned, the effect of one barrier is propagated throughout the system and may be fed back to the same barrier - either reinforcing or suppressing it, or resulting in another barrier. In demonstrating this, Painuly (2000: 80) explains that an unstable macro-economic environment, which is itself a result of various regulatory barriers, may “increase risk and uncertainty for new investments”, which then results in economic barriers in terms of the lack of project funding by investors.

However, the situation where RETs are not price-competitive compared to conventional technologies is not permanent. Technology learning curves: which demonstrate the learning effect, measured “in terms of reduction in the unit cost (or price) of a product as a function of experience gained from an increase in its cumulative capacity or output” (Jamash & Kohler, 2007: 2), demonstrate the potential of RETs to economically challenge conventional energy technologies. It is especially emphasised that the reduction in costs is not measured against time, but specifically against experience, as this model stems from a learning-by-doing approach. Kobos, Erickson & Drennen (2005) assert that appropriate policy measures can result in significant reductions in costs of RETs and their market penetration. These authors present Figure 2-5 below, which demonstrates the reductions in cost as technology learning is achieved ‘by doing’, i.e., through cumulative installations.

These figures indicate that non-cost competitiveness is fast diminishing as a barrier, as the cumulative experience of various technologies increases and their costs decrease. This is coupled with fossil fuel technologies “having exhausted nearly all of the options for technological improvement and encountering the diseconomies of scale inherent in reliance upon finite inventories of natural resources” (Schilling & Esmundo, 2009: 1773).

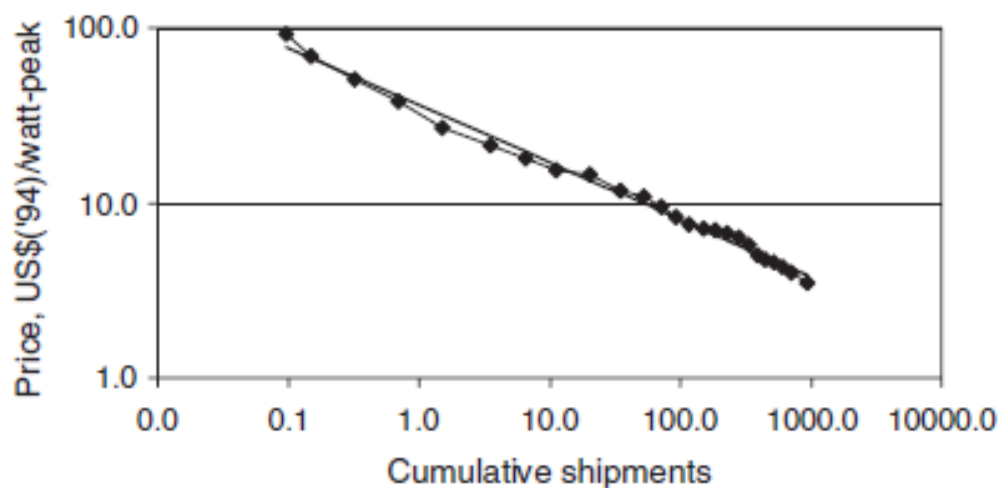
Figure 2-5: Conceptual demonstration of relationship of technology cost and price with cumulative installations



Source: Kobos et al. (2005), citing Boston Consulting Group (1968).

Kobos et al. (2005) also present Figure 2-6 below, which demonstrates the learning or experience curve of PV modules. What must be noted is that PV technology has, since 1994, come a long way and so the costs per watt-peak have come down much further than the picture depicts. What is taken from this graph, nonetheless, is the potential impact of increased installations of RETs on cost reduction in the South African context. Laura Luckhurst of First Solar, a participant in the DoE's REIPPPP, indicated that First Solar's thin-film PV technology is already cost competitive with conventional energy in South Africa. This is a result of the technology's global installed volume, hence lower production costs, and of the company's own learning in the South African renewable energy space (Luckhurst, 2013). This increased capacity and learning will bring about much needed grid parity: the situation in which RET generated electricity will cost as much as conventional (coal fired) electricity. Thus, what learning curves call for is a longer term consideration of the viability of RETs, where their implementation today has a two-fold benefit: (a) lowering costs with increasing installed volume; and (b) contributing to the climate change mitigation and sustainable development effort - an effort that must be made sooner rather than later.

Figure 2-6: Experience curve of PV modules



Source: Kobos et al. (2005), citing Harmon (2000).

2.5.2. Institutional, political and regulatory barriers

Krupa & Burch (2011: 6256) note that “inappropriate politicization”- as found in South Africa's electricity sector, hinders the implementation of RETs as vested interests from key stakeholders tend to inhibit the decision-making process. These barriers are what

Painuly (2000) refers to as institutional, political and regulatory barriers. This inevitably interrupts the flow of information about regulations governing RETs to end-users and producers. These barriers are exemplified by the high cost of renewable energy-generation permits. This, Philibert (2006) asserts, is a result of the institutions managing them often being under-skilled and steeped in bureaucracy, therefore placing “unnecessary conditions on projects, adding to the complexity and cost” (Philibert, 2006: 19) of the implementation process. Although Philibert’s (2006) case study is about solar thermal technologies, similar barriers are faced by other RETs.

Sebitosi & Pillay (2008b) present Sweden as an example manifesting this type of barrier. In Sweden “the biggest challenge for the new RE industry was from an incumbent well-entrenched nuclear industry”, while in the South African case, the challenge is a heavy dependence on the well-entrenched coal industry Sebitosi & Pillay (2008b: 2213). Sebitosi & Pillay (2008b: 3312) also point out that “[p]olicy consistency and continuity would also appear to be critical to success as evidence has shown that growth and new investment suffered... during times of policy gaps”. The notion of consistent and continuous policy draws a sharp parallel to the idea of complex systems being open to their environment. In their openness, complex systems constantly exchange information and energy with their surroundings, and therefore operate “at conditions far from equilibrium” (Cilliers, 2000: 24). In the case of South Africa, if the system is not open and responsive to stimuli, both internal and external, it runs the risk of not sufficiently adapting and therefore falling into chaos - as made evident by the electricity shortages of 2007/2008. Again, it is noted that municipalities are best positioned to ensure the system’s responsiveness, due to their proximity to the citizenry and therefore best placed to assess the impact of policy changes.

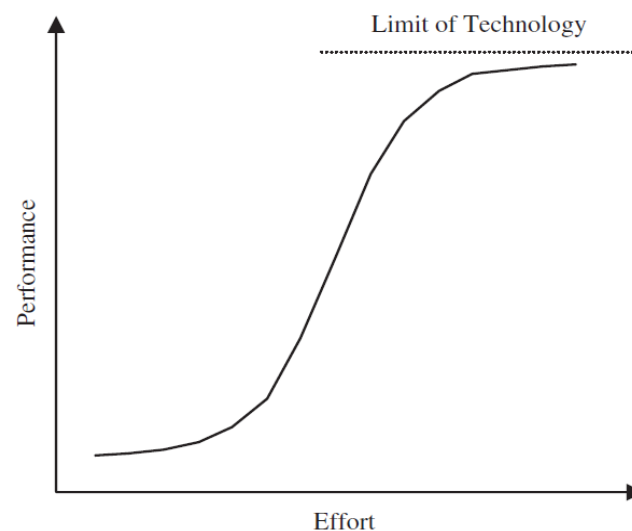
2.5.3. Technical barriers

This barrier can manifest itself in the form of (a) a lack of technology standards; (b) a shortage of skills and entrepreneurs; and (c) a lack of adequate renewable resources (Painuly, 2000). In the case of solar thermal technologies, Philibert (2006: 14) indicates that competence of engineers and installers plays a role, such that “systems may not work properly if not installed carefully”. A lack of entrepreneurs is also cited as a technological barrier, resulting in a lack of competition and subsequently, in supply constraints.

The use of technology S-curves to depict the change in improvement of a technology with increasing effort (usually in the form of money invested in R&D) provides an alternative perspective through which to perceive technical barriers. A typical S-curve is shown in Figure 2-7 below.

Schilling & Esmundo (2008) explain that in the early stages of technology development, a lot of effort is required to achieve small improvements as the fundamentals of the technology are still being learnt. As more experience is gained and developers hone in on those areas which make the most progress, there is a rapid increase in performance (Schilling & Esmundo, 2008). Ultimately a technology will reach some inherent limit and small improvements in performance will require increasingly larger investments. At this stage, the curve flattens out, or alternatively a disruptive technology enters the scene and cuts short the life of the previous technology.

Figure 2-7: Typical S-curve of technology improvement.



Source: Schilling & Esmundo (2008).

On considering the location of various RETs on the S-curve in comparison to conventional energy technologies (especially in the South African case of coal fired generation), it strengthens the case for RETs, as the former are approaching their performance limits (Schilling & Esmundo, 2008). On the other hand, many RETs are found lower on the S-curve and, therefore, are seen as uncompetitive. However, coupling the *potential* of these RETs with their rapid learning rates, reduces the significance of perceived economic barriers, especially those resulting from technological barriers in the mid- to long-term.

Another crucial point that cannot be over-emphasised is that of the negative environmental impacts of conventional energy technologies. Additionally, fossil fuels are finite and a further reliance on this type of energy is risky for future planning. Thus, in building the business case for RETs, their comparison with conventional energy technologies must somehow include the (as yet) non-fiscal costs of environmental degradation caused by the use of the latter technologies.

2.5.4. Barriers: The case of South Africa

South Africa's longstanding history of dependence on coal-fired electricity generation resulted in some of the world's cheapest electricity, initially rendering RETs far less cost-competitive than conventional energy technologies (Sebitosi & Pillay, 2008a, 2008b; Pegels, 2010; Krupa & Burch, 2011). This history has also led to the situation where conventional energy is directly and indirectly subsidised, and this is what Philibert (2006) cites as an economic barrier to the growth of RETs. To demonstrate this, Sebitosi & Pillay (2008a: 2514) note that "for every 1 rand invested in renewable, 1000 have been invested in a next generation nuclear program". Although the Pebble Bed Modular Reactor (PBMR) programme has since collapsed, the distortions in financial support of energy technologies remain incredibly biased against RETs. This distortion is evident in the government's 2003 announcement of a 10,000GWh target for renewable energy contribution to final consumption by 2013 (Republic of South Africa, 2003b), which was ironically followed by the commissioning of the coal-fired mega-plants, Medupi and Kusile. In 2012 these plants were reported to cost R116 billion and R158 billion respectively (Mail & Guardian, 2012).

This history, has contributed to the politicization that Pegels (2010) refers to, resulting in a web of political and consequently regulatory barriers. Eskom and Sasol, for example, are the largest local investors in energy research and development (R&D) yet have heavily vested interests in conventional energy technologies, especially coal-related technologies. This inherently hampers their interest in RET investments. Furthermore, Krupa & Burch (2011) assert that only the African National Congress' (ANC) investment arm, Chancellor House, is poised to benefit from Eskom's continued market monopoly. This close-knit relationship between the ruling party and the parastatal is yet another example of the over-politicization that Pegels (2010) refers to. Sebitosi & Pillay (2008b) reiterate this lack of political will on the part of government, demonstrated by the fact that in 2008 (the publishing year of their article), five years had already passed since

government published the White Paper on Renewable Energy (DME, 2003), yet no strategic plan had been developed to facilitate the growth of RETs. Only now, five years since their publication, and ten years since the White Paper, is there visible progress on the renewable energy scene with the implementation of the REIPPPP. Even so, projects which won the first bidding window (which opened towards the end of 2011) are only now in their construction phases- although, some projects are expected to come online by the end of 2013.

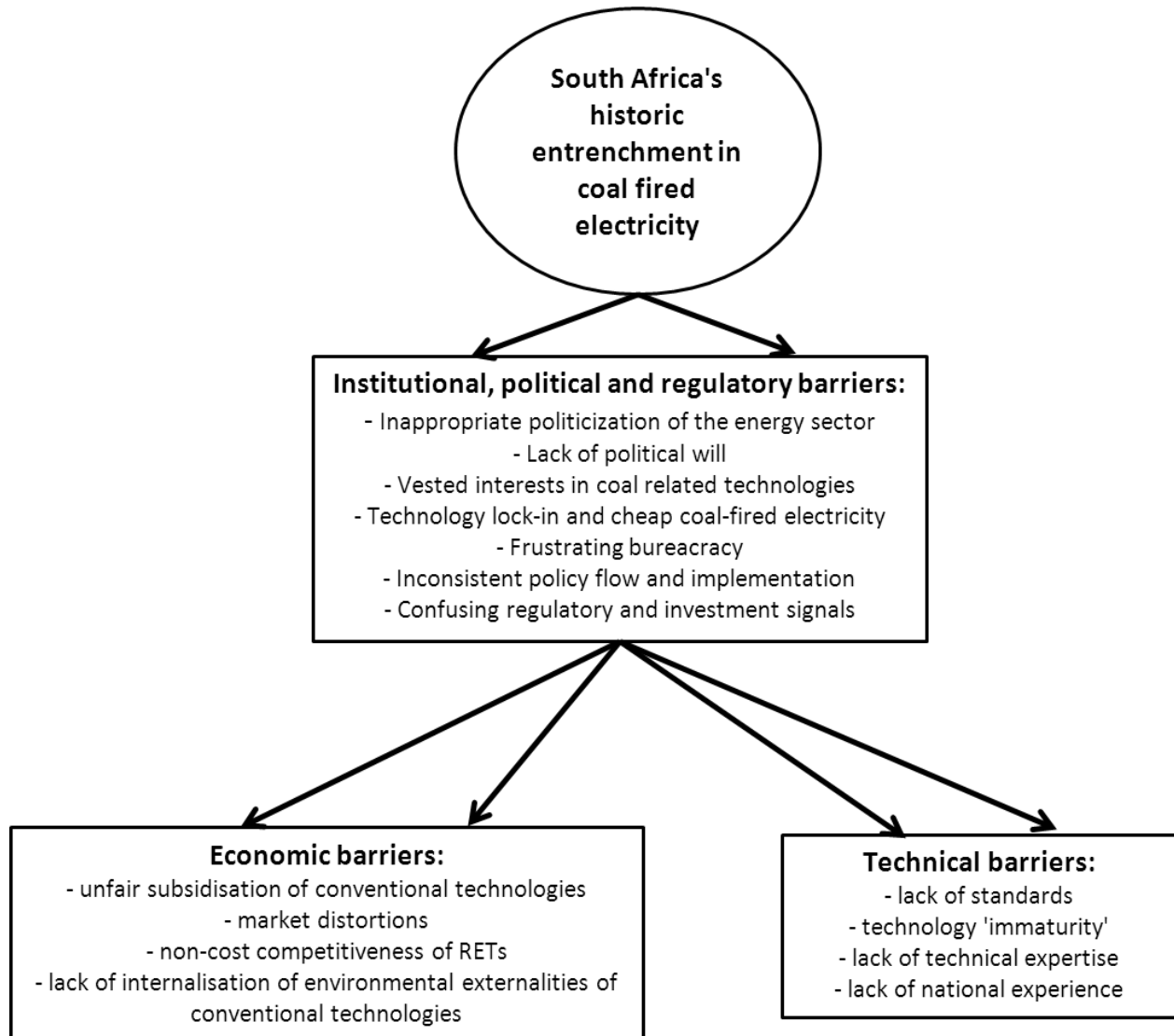
Pegels (2010: 4949) points out that given the capacity and financial constraints on Eskom “it is doubtful that there will be enough funds available or political will to invest money in comparatively expensive and risky renewable energy technologies”. It is interesting to note, however, that in 2012 Eskom proposed a tariff of R0.97/kWh to parliament for electricity from Medupi, making it more expensive than wind energy (at R0.89/kWh) under the renewable energy procurement programme (Mail & Guardian, 2012). Krupa & Burch (2011) also report that numerous civil servants have vested interests in companies doing business with government, yet fail to declare these connections during tendering processes. Krupa & Burch (2011: 6258) point out the ultimate result of these institutional barriers, namely that,

“...confusing regulatory and investment signals have been sent out, as the numerous individuals that must come together to confirm the final components of the renewable energy policies remain disjointed” (Krupa & Burch, 2011: 6258).

This disjointed effort has itself culminated in the “failure of numerous renewable energy documents to set concrete, workable targets” (Krupa & Burch, 2011: 6258) and therefore failure to create a reliable environment that attracts investors and project developers.

2.6. Concluding on the South African case

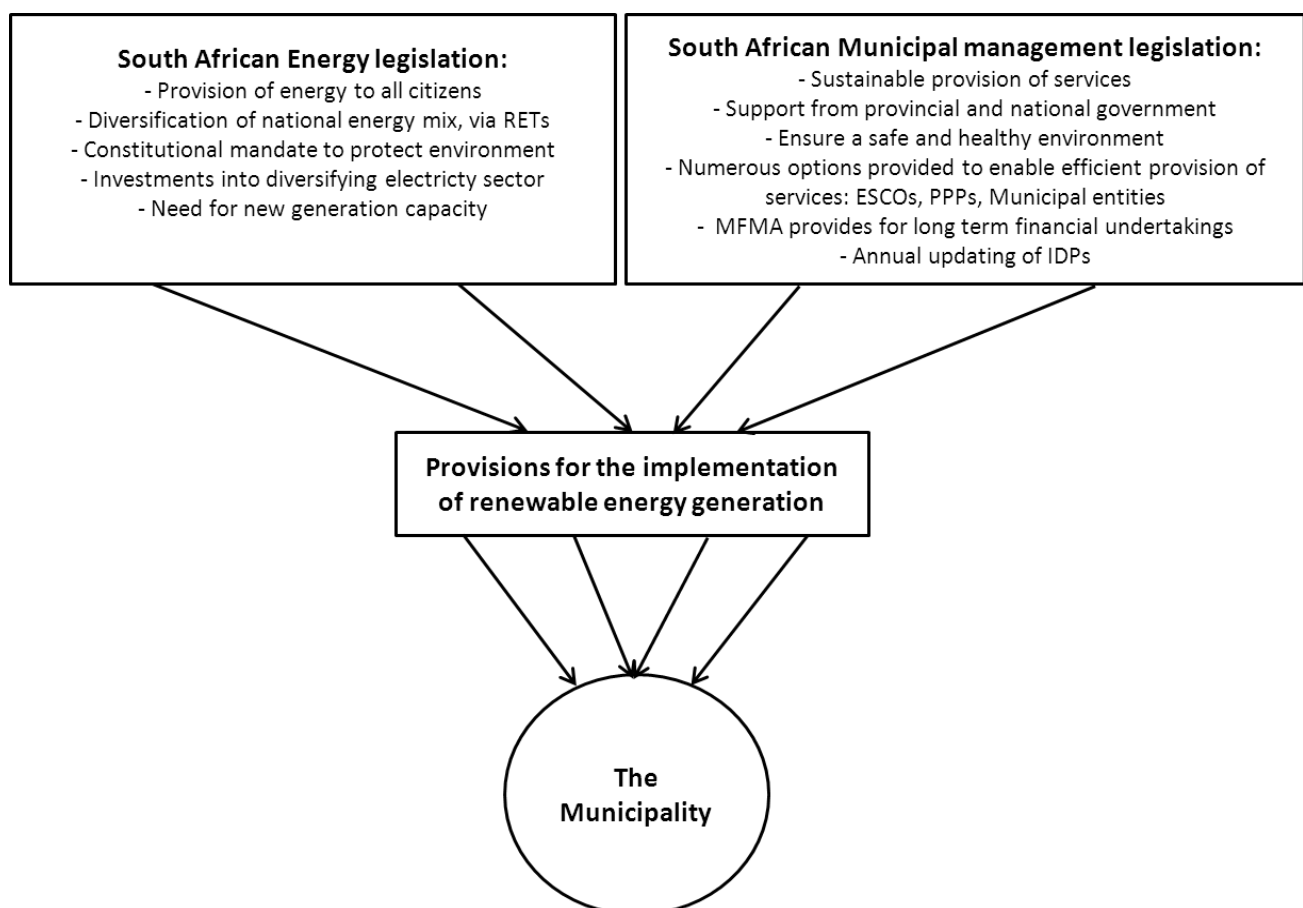
Figure 2-8: Hierarchy of barriers to RETs in South Africa



The discussion held on barriers in section 2.5 is depicted above in a hierarchical structure and summarised pictorially in Figure 2-8. Barriers to the implementation of RETs arise from South Africa's historic entrenchment and dependence on cheap, coal-fired electricity. This history, embedded in the system, has birthed institutions inherently biased towards conventional energy technologies and therefore inhibiting to the growth of RETs. Vested interests on the part of key institutions and decision-makers hinder the creation of appropriate policies to foster RETs, resulting in confusing and frustrating regulatory signals for project developers and investors. These barriers spill over into (a) economic barriers, manifested as the grossly uneven subsidisation of conventional technologies over RETs and the accompanying non-internalisation of the environmental

externalities of fossil fuels, which contribute to the apparent non-cost competitiveness of RETs; and (b) technical barriers evident in the lack of standards and experience with RETs by local project developers and manufacturers, a result of the technological lock-in that accompanies a heavy dependence on a single technology as South Africa has on coal. Thus, in the South African case, institutional, political and regulatory barriers are the dominant barriers to the implementation of renewable energy technologies. Municipalities, however, provide a unique opportunity to overcome this situation through effecting a change in the system's behaviour over time by facilitating learning and an appropriate-policy development process. This is shown in summary in Figure 2-9 below.

Figure 2-9: Summary of provisions made in legislation for RETs via the municipality



The numerous policy documents, regulations and strategies cited in sections 2.3 and 2.4, and shown in summary in Figure 2-9, demonstrate the many provisions for the growth of RETs. From constitutional mandates for municipalities to ensure sustainable provision of basic services, to Acts calling for the diversification of the energy sector through investments in renewable energy generation, policy is increasingly poised to nurture the growth of RETs. Krupa & Burch (2011) recognise RETs as having the potential to

address issues of marginalization and environmental destruction - central themes to South African society today. Again, municipalities are suggested as capable of spearheading the acceleration of the growth of RETs in South Africa. Given the current drive towards large scale renewable energy projects, as seen in the REIPPPP, what is left for the municipality is to focus on smaller scale RETs that can address South Africa's energy challenges at the grassroots level. Mentioned in this discussion is the ability of RETs to address issues of marginalization (Krupa & Burch, 2011), and this can involve RETs in the most rural of locations; where the only energy requirement may be for charging of cellular phones to increase communication. At the same time, the increasing cost of conventional electricity contributes to the municipal dilemma where even suburban customers now seek alternative, more affordable, energy sources- presenting yet another space in which the municipality can play a leading role. Currently, only Eskom is mandated with the distribution of electricity, however municipalities can reticulate this electricity within their grids and so have the opportunity to play their part at this level – the cumulative results of which this discussion envisages to be positively significant.

From a complex systems theory perspective, the municipality is seen as a strategic component of the system in the South African context by virtue of being best positioned closest to the citizenry, and best poised to make use of RETs to address issues of energy marginalization. By taking advantage of their legal authority to develop by-laws, municipalities can create conducive environments for RETs within their jurisdiction, and so contribute to the larger system's learning and experience with RETs, ultimately removing RETs as a threat to municipal revenue. To elaborate on this further: small-scale implementation of RETs at the municipal level can potentially be a place holder during the transition to a more sustainable (both economically and environmentally) energy sector in South Africa. While larger generation projects take time to come online, smaller scale projects at the household level, for example, can come online almost immediately, therefore having a more immediate impact.

Municipalities can take advantage of an increasingly conducive policy landscape, especially through processes such as the yearly iterations of municipal IDPs. Such processes allow for learning, long-term capacity development, evolution and ultimately for municipalities to become key components in challenging the institutional, political and regulatory barriers which are seen to impede progress towards sustainable development in the energy sector. As per the tenets of complex systems theory, a complex

system must (a) continually exchange information with its environment, (b) be dynamic and (c) respond to both internal and external stimuli. The municipality, therefore, is positioned as a key facilitator of this process for the survival of the 'South African context'. Given the challenges of the 21st century, namely the quest for sustainable development and climate change mitigation, RETs are poised to take centre stage by addressing the municipal dilemma and thereby contributing to the survival of the larger system.

It is, however, recognised that the focus of this literature analysis has been on higher level policy opportunities and barriers to RETs, whereas to obtain a more complete perspective of the municipal dilemma some deeper research is required. This research must illuminate the municipal dilemma from the perspective of the municipality and also seek out means of addressing the situation from the very institutions tasked with doing so.

Chapter 3: Journal article 2

3. Tackling the municipal dilemma: A case study of Hessequa Municipality

3.1. Introduction

The City of Cape Town's (CoCT) energy and climate change strategy powerfully states the current position of local government, and more specifically, of municipalities. It asserts that,

“[t]he core role of energy within cities is being increasingly recognised by local authorities internationally for its importance in socio-economic development, its impact on the local, national, regional and international environment, and its impact on a variety of social concerns including poverty, health and gender-related matters” (CoCT, 2005: 5).

The role of municipalities is thus evolving, from simple extensions of national government, to more dynamic and significant contributors to national development. The generation and reticulation of energy, and more specifically electricity, has been and continues to be central to South Africa's economy and to the municipalities' sustainability. The country's abundant supply of coal has resulted in “a legacy of low energy prices and a history of high energy intensity within its main industrial sub-sectors” (eThekweni Municipality, 2008: 52). Skeen & Spencer, 2012: 77) recognise this legacy, and the resulting,

“...market dominance of Eskom and Sasol in the South African energy sector, and the technological lock-in effects that go hand-in-hand with an energy system that is heavily reliant on a single source of energy”.

This history, locked in coal dependence and traditionally low electricity prices, is highly influential in the country's energy sector, resulting in institutional, political and regulatory barriers (Painuly, 2000) to the growth of renewable energy technologies (RETs).

Municipalities find themselves in the midst of a three-way dilemma: (a) the 21st century's calls for sustainable development and climate change mitigation, (b) South Africa's historic coal dependence and (c) uncertainty about their legal jurisdiction as electricity

providers. This situation results in what is herein referred to as the ‘municipal dilemma’, which describes the nexus between:

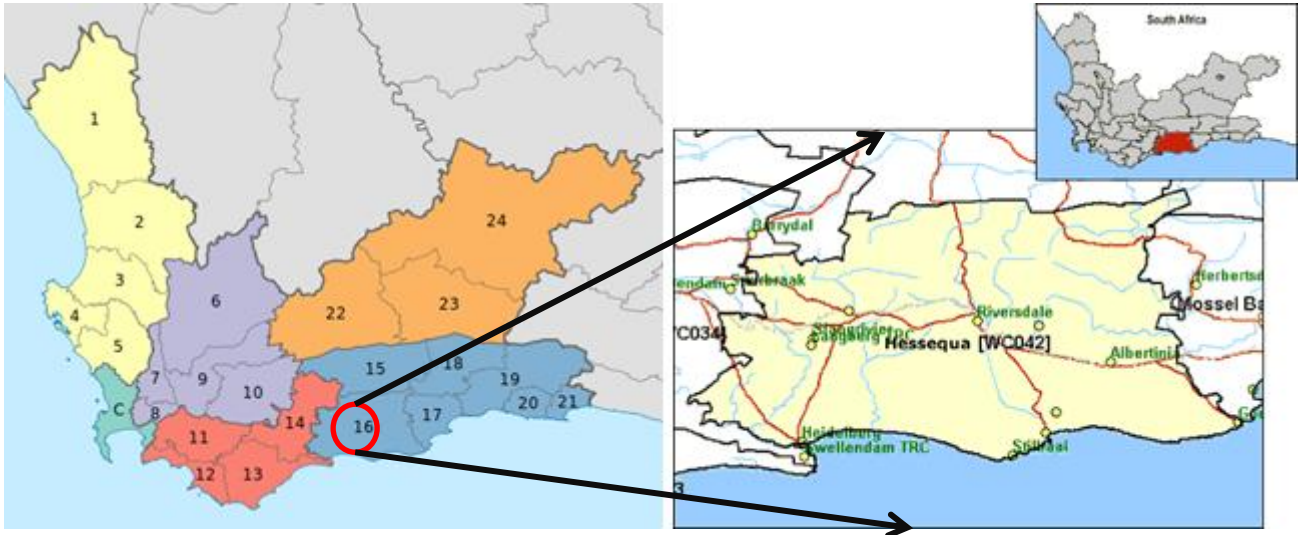
- Constitutional mandates for the municipality to provide basic services.
- The possible financial risks of implementing RETs.
- The regulatory ambiguity surrounding electricity generation and distribution jurisdiction.
- The necessary implementation of RETs: as a means of addressing the growing risk of revenue loss from reduced electricity sales as own generation, via RETs, increases; and as a contribution to national climate change mitigation efforts.

3.1.1. Introduction to Hessequa Municipality

Hessequa Municipality is located in the Eden district of the Western Cape Province. Eden district municipality consists of the municipalities numbered 15 to 21 in Figure 3-1, with Hessequa Municipality located in area 16. The municipality consists of several dispersed towns, namely: Riversdale, Stilbaai, Witsand, Jongersfontein, Heidelberg, Gouritsmond, Slangrivier, and Albertinia. Riversdale, located in the centre of Hessequa, is the main town and seats the main municipal offices. Hessequa Municipality has been pro-active in many renewable energy and sustainable development initiatives. Through a Memorandum of Understanding (MOU) between the municipality and Stellenbosch University (Botman & Nel, 2011) Hessequa has commissioned studies by the Centre for Renewable and Sustainable Energy Studies (CRSES) that will inform decisions around achieving the municipality’s *Green Vision* (Hessequa Municipality, 2012). This current study adds to this growing body of knowledge by using Hessequa as a case study to better understand the ‘municipal dilemma’ and what means there are to overcome it.

Figure 3-1: Map of the Western Cape, locating Hessequa Municipality

The N2 national highway cuts almost centrally across the municipality, providing essential infrastructure to connect the sparsely located areas, especially the three main centres of Heidelberg, Riversdale and Albertinia.

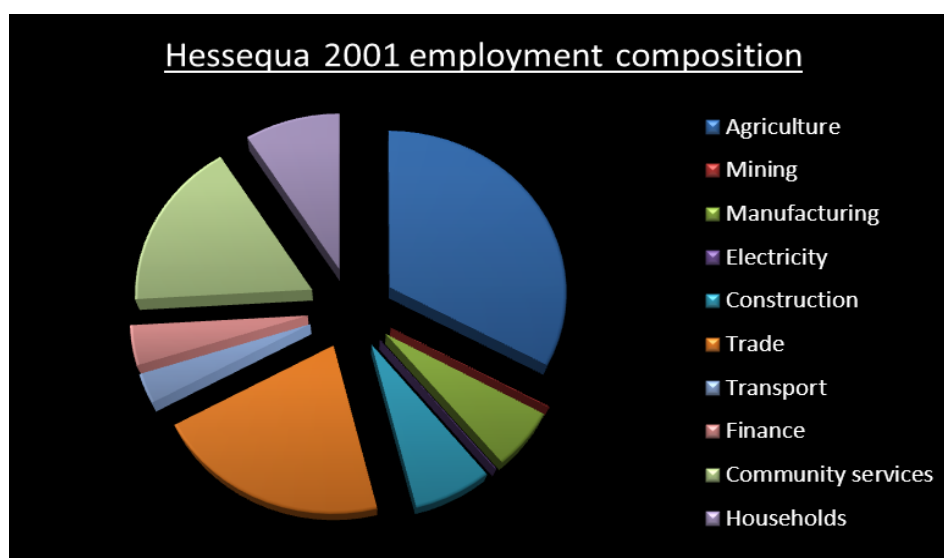


3.1.1.1. Hessequa's economy

A property boom between 2001 and the global economic troubles of 2007/2008 changed the composition of the municipality's economy (Hessequa, 2011). Hessequa's economy was once dominated by the agricultural sector, which in 2001 was responsible for creating 31% of the area's employment (Hessequa, 2011). In 2010 this figure decreased to 14%, mainly as a result of an increase in trade and construction (Hessequa, 2011). This change is evident through Figure 3-2 and Figure 3-3 below.

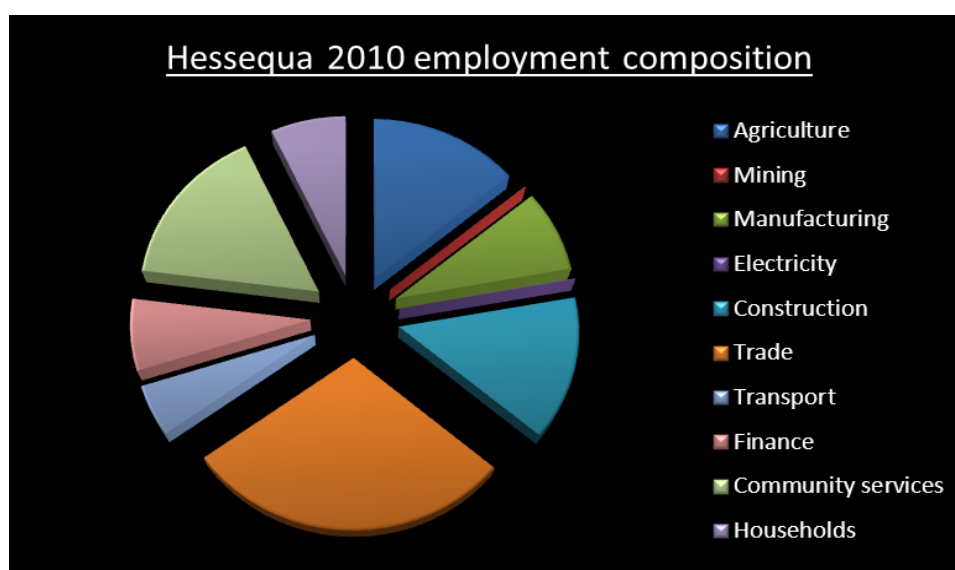
Hessequa's Integrated Development Plan (IDP) 2012 – 2016 (Hessequa Municipality, 2011: 96) recognises this shift in the region's economy and calls for "a complete overhaul of [Hessequa's] economic development approach". This recognition also implies a change in the municipality's energy sources. Energy, especially in the form of electrical energy, is a major driving force in the economy.

Figure 3-2: Employment structure of the Hessequa Municipality region, 2001



Source: Hessequa Municipality (2011)

Figure 3-3: Employment structure of the Hessequa Municipality region, 2010



Source: Hessequa Municipality (2011)

3.1.1.2. Hessequa Municipality's 'Green Vision'

To complement both the shift in the economy and the energy overhaul, the need was identified to adapt the municipality's development approach. To achieve sustainable development, the municipality developed a 'Green Vision' which it hopes to achieve by

2020. The section below details some of the vision's key tenets (Hessequa Municipality, 2011: 128):

“To be the first municipality in South Africa to be truly Green and by 2020 to be:

- energy and carbon neutral
- a zero waste society
- building low carbon footprint settlements which are fully integrated
- actively restoring, protecting and managing our eco- and river systems to ensure water security for all who live here now and into the future.”

What is interesting to note for this study, is that renewable energy generation will help fulfil two of these objectives, namely energy and carbon neutrality and to achieve low carbon footprints. As Krupa & Burch (2011: 6259) point out, renewable energy has the potential to “simultaneously address marginalization and environmental degradation concerns”.

Through the establishment of a municipal Independent Power Producer (IPP) entity (Hessequa Municipality, 2011), the municipality has embarked on various renewable energy projects. These include: (a) a 33kW solar plant in Riversdale- with the potential to increase to 5MW; (b) a 500kW biogas-from-landfill plant in Riversdale; (c) a 1 – 20MW solar PV plant on the outskirts of Riversdale; (d) a 10MW solar PV plant on the outskirts of Melkhoutfontein; (e) a 6MW wind farm in Melkhoutfontein; and (f) a 6MW gasification waste-to-energy plant in Riversdale close to the industrial area. These projects are at different stages of planning and execution, but are symbolic of the municipality's commitment to its ‘Green Vision’ and therefore, to achieving sustainable development. The private sector is also contributing to this vision with numerous planned renewable energy and “green economic activities” (Hessequa Municipality, 2011: 130) in the pipeline. These projects include: (a) a 6MW wind farm in Stilbaai; (b) a 10 – 20MW wind farm in Botterkloof; (c) a 10MW wind farm in Heidelberg; and (d) a 10MW wind farm in Gouritsmond. The municipality's substantial experience in engaging in renewable energy projects makes for a suitable case study to determine the barriers to municipal implementation of renewable energy generation, as well as opportunities.

The author notes that Hessequa's 'Green Vision' has actually gone a long way in facilitating the implementation of RE generation projects. Not only are various generation projects already underway, under the banner of the Green Vision, but the municipality has already set up an IPP that has developed a PV plant within the municipal jurisdiction. What is needed henceforth is consistency in the municipality's efforts, and this is reiterated by the insights discussed in the sections to follow.

3.1.2. Aims and objectives

Brent, Guy & Mosdell (2012) indicate that decisions regarding energy efficiency and renewable energy projects are facilitated by the decision-makers' knowledge or confidence that they act within their mandate. Thus, in order for this study to assist South African municipalities in addressing the municipal dilemma it must determine (a) the barriers that municipalities face when engaging with RETs, and (b) the possible means of overcoming these barriers. To determine the latter, it was necessary to explore a wider range of examples of successful RET implementation. This led to the investigation of both international and local examples of programmes and projects that implemented RETs. This is elaborated further in section 3.2 below.

Janisch, Euston-Brown & Borchers (2012) indicate that unmediated implementation of renewable energy generation by consumers has the potential to significantly impact on municipal revenue, and negatively so. This same concern is voiced by Hessequa Municipality (refer to section 3.4.1 below). In the light of these concerns and noting the potential of municipalities to significantly contribute to South Africa's RET implementation effort, this study aims to assist South African municipalities in overcoming the municipal dilemma. The objectives of this study are therefore to:

- Provide relevant lessons to municipalities, from cases of successful implementation of renewable energy generation from international and local case studies.
- Determine the municipality's perspective on the barriers to municipal implementation of renewable energy generation.
- Determine possible means of addressing these barriers; linking the municipality's perspective on possible means of doing so with lessons from other case studies.

Prior to a discussion on the insights gained from the case study of Hessequa Municipality, it was deemed necessary to explore lessons from cases of RET implementation, both globally and locally. This brief literature analysis is to reinforce lessons gained from Hessequa Municipality and to also allow parallels to be drawn across a variety of cases, enabling key points on successful implementation to be drawn out more explicitly.

The initial plan with regard to this case study was to research into Hessequa Municipality only, but the research process led to the insight that what was needed, and more useful, were recommendations applicable across a wider range of municipalities. To achieve this, a wider perspective was required, necessitating the following literature survey on successful implementation of RETs, internationally and locally. This also proved useful as a means of confirming the insights gained from Hessequa Municipality, as highlighted throughout the discussion to follow.

3.2. Literature on global and local cases of RET implementation

This literature survey provides relevant lessons from selected international and local cases of successful RET implementation. These will inform the recommendations to be made to Hessequa Municipality, and beyond that, to provide lessons to all municipalities embarking on the renewable energy implementation journey. Again, it must be reiterated that the choice of international case studies- of Brazil and India- was based on the understanding that as members of BRICS (Brazil, Russia, India, China, South Africa) these countries would have similar economies and challenges to South Africa. Furthermore, as these countries represent stronger and larger economies, and faster growing economies than South Africa, it is hoped that the lessons they have to teach, South Africa can do well to learn from.

3.2.1. Lessons from Brazil

Brazil, a member of the BRICS group, is one of the largest developing nations and bears a striking similarity to South Africa. Geller, Schaeffer, Szklo & Tolmasquim (2004: 1439) note that the aims and objectives of Brazil's energy sector, like those of many developing countries, are:

- “Ensuring an adequate energy supply, thereby avoiding shortages
- Limiting the investment requirements for meeting the country's energy service needs
- Fostering social development”.

Eskom, being South Africa's sole main generation utility, shares these objectives while also facing the challenges of a tight operating margin- and therefore an ever increasing need to increase capacity- and serious financial constraints. Brazil's economy, like South Africa's, also underwent rapid growth as a result of mineral-wealth. To meet a growing energy demand, and ever-increasing projections, the country had to find cost-effective means of generation, and renewable energy was poised to address this need. The need for cost-effective generation, above all else, was a result of increasing capacity being a costly activity which diverted money away from other economic activities (Geller et al., 2004). South Africa faces a similar situation and so will do well to learn from Brazil's example. Furthermore, in the South African case what must be considered are the costs of the current major energy source's environmental impact- both locally and globally. Geller et al. (2004) present numerous policies that were aimed at addressing Brazil's

increasing energy need. A select few of these, based on applicability to the South African context are highlighted below - especially those applicable at the municipal level.

First, to address the issue of a growing population that requires housing, Brazil adopted energy codes for new commercial buildings. These worked to restrain the increasing energy demand that comes with new buildings coming online, by making them more energy efficient. This same thinking can be applied to houses in the Reconstruction and Development Programme (RDP) and to houses in the burgeoning ‘gap’ market. Standards, including the SWHs installation requirement that is now in place, can be enforced by municipalities, as they are best positioned to oversee their implementation. This will assist both national efforts at providing basic energy needs and easing capacity constraints, while enabling municipalities to deliver electricity to a larger population. Considering that domestic users constituted over 90% of Eskom’s total users and accounted for almost 20% of electricity consumed in 2006 (NERSA, 2006), but more importantly that they are majorly responsible for the daily peaks that give rise to capacity constraints, simple measures in this sector have the potential to make a significant impact.

Another policy option used in Brazil was a requirement for all utilities to spend at least 1% of their revenue on energy efficiency programmes; both at the utility level and the end-user level (Geller et al., 2004). This policy option, in the case of South Africa, could add to the funding sources for the implementation of energy efficiency and alternative energy regulations such as the building codes cited above. South Africa’s advantage with regards to this policy option is that there is only one utility - Eskom - so the implementation of such a policy would be much simpler.

Thirdly, is the idea of consistent policy. Sebitosi & Pillay (2008b: 3312) allude to the notion of policy consistency and continuity as being “critical to success as evidence has shown that growth and new investment suffered . . . during times of policy gaps”. The long term feed-in tariffs guaranteed in Brazil for wind power reflect this notion of policy consistency. The call here is for planning that ensures a secure environment for investments. South Africa’s renewable energy independent power producer procurement programme (REIPPPP) is evidence of a move in this direction already. Extending the REIPPPP programme to the municipal level would see municipalities entering into PPA’s with ESCOs and working out suitable tariff structures to ensure that the

municipality's electricity business remains sustainable while competitive prices are offered to the citizenry. Work done by Reinecke, Leonard, Kritizinger, Bekker & Thilo (2013), entitled *Unlocking the Rooftop PV Market in South Africa*, already attempts to investigate the options available for municipalities.

Brazil, as in South Africa, also faced the challenge of universal electrification. To address this challenge, a programme known as "PRODEEM installed about 5700 solar photovoltaic (PV) systems in off-grid areas" (Geller et al., 2004: 1445). This programme failed due to, among other factors, a lack of ownership of the installations by the recipients. A better approach is suggested, wherein local economies are created in these poorer areas "by supporting solar energy entrepreneurs as well as providing attractive micro-financing and subsidies to households that are not yet connected to the power grid" (Geller et al., 2004: 1445). Geller et al. (2004: 1445 – 1446) note that "[t]his type of integrated strategy that addresses both supply and demand has proven successful in solar PV programs in other countries such as India and Japan". Thus, not only does this approach create local economies, which falls in line with municipalities' mandate to ensure economic development, but it also avoids the large costs of extending the grid to areas of low population density, while still providing basic services – yet another municipal constitutional mandate.

Common lessons from Brazil, which resonate through the other cases explored, including Hessequa Municipality, include: (a) the need to ensure ownership of mass rollout programmes, so that potentially beneficial projects do not fall victim to vandalism or neglect and therefore failure; and (b) the notion that small scale distributed generation, which can be managed at the municipal level, can significantly contribute to national development efforts.

3.2.2. Lessons from India

India, another member of BRICS and sharing similar concerns to South Africa vis-à-vis energy supply and development, provides yet more lessons. In India concerns about "the stability and security of the supply of energy, as well as sustainable development, are the key issues, more so than climate change" (IEA, 2009: 123). South Africa shares the same concerns with regard to security of supply and development – and South Africa also supports the Kyoto Protocol's call for climate change mitigation commitments.

The electricity crisis of 2007/2008 has left South Africans increasingly aware of the strain borne by Eskom, which has resulted in an increasingly conducive environment for

the growth of renewable energy generation. Schmid (2012: 322) indicates that in India “state-level policies seem to have had a stronger impact on the development of the share of REP [Renewable Energy Power]”. Translated to the South African context, this calls for more localised efforts to support RETs via mechanisms such as the creation of conducive by-laws and provincial regulations and standards.

Many South African municipalities, Hessequa Municipality included, often cite a lack of funds as a major barrier to the implementation of RETs, as discussed in section 3.4 – to follow. Schmid (2012), however, notes that in India, this issue is overcome by harnessing investments from the private sector. Areas rich in renewable energy resources partner with private funders in mutually beneficial arrangements that result in the growth of renewable energy generation projects. Nagpur, a town in India, for example, has established the Nagpur Municipal Corporation through which it manages all renewable energy projects. It is noted that the *Local Government: Municipal Finance Management (MFMA) Act 56 of 2003* (Republic of South Africa, 2003) allows for the establishment of municipal entities, which local municipalities can use as vehicles to grow RETs. Another measure to increase access to funds, Schmid (2012) suggests, is to develop capacity, at the regional level, to collect quality data. This “would allow for a better assessment of the impact of environmental policy instruments, and would give an empirical ground” (Schmid, 2012: 324) to claims for financial support for climate-change mitigation efforts from institutions such as the Clean Development Mechanism (CDM).

A useful strategy to ease-in RETs is further demonstrated by Nagpur. Instead of installing large utility-scale solar plants, Nagpur invested in “small-scale solar power generation for street lights, garden lights, traffic lights, advertisement hoardings and solar water heaters” (IEA, 2009: 124). This approach has multiple advantages, including allowing for systematic implementation of technologies which, in turn, allows the locality to learn from each project while gradually increasing public awareness of the benefits of RETs. As further means to achieving these visions, the city has opened itself up to consultations with other cities and various stakeholders in the renewable energy space; hosting conferences, round table discussions and other awareness campaigns. To increase awareness and develop capacity in the renewable space, Nagpur also established a Renewable Energy Resource Centre.

India provides numerous lessons also common across several of the cases explored. (a) It demonstrates that state-level (province-level in South Africa) driven policies, as opposed to national policies, are more successful in growing the share of RE generation in the country's supply mix. This study argues for this idea to be extended to municipal level, where the drive for increased RE generation comes from municipalities implementing RETs. The beginnings of this drive are seen in all the local case studies discussed, including Hessequa. As seen in the literature analysis, municipalities have the opportunity to act as internal stimuli to the larger system, as per the tenets of complex systems theory. (b) Another insight gained regards the challenge of a lack of funds - the top barrier according to Hessequa municipality. In India, states rich in RE resources, but lacking financial clout enter into arrangements with the private sector. (c) Another theme observed, which effectively maximised benefits from such arrangements, was the need to establish municipal capacity to manage RE related activities.

3.2.3. Lessons at home - the case of eThekweni Municipality

eThekweni municipality, located in the KwaZulu-Natal (KZN) province, is an example closer to home. eThekweni municipality's own efforts ride on the wave of those efforts by the KZN provincial government, which were, in turn, aligned with government's 10,000GWh renewable energy target (KZN, 2007). This alignment of efforts, from national, provincial and through to local government is crucial to the success of renewable energy efforts as it is a key to unlocking national and international funding under the umbrella of national climate change mitigation efforts. In line with the ideas that this study motivates, the KZN Department of Economic Development (DED) recognises that,

“...a model is emerging, both in South Africa, and in other mainly developing countries involving the securing of funding for small, medium and large-scale individual renewable energy-related projects. Such projects are slowly becoming more viable as the international environment is highly supportive of such initiatives and as such funding is readily available” (KZN, 2007: 47)

To successfully take advantage of this model, according to the KZN DED (KZN, 2007: 54), municipalities should work to integrate technology implementation into “the broader developmental objectives and activities of the province”.

Another common theme is the notion of aligning municipal efforts with provincial programmes. Elaborating on this further, the author suggests that this alignment is actually one half of a full feedback loop, where the municipality, a component of a larger complex system, influences the larger system and is in turn influenced by the system.

As in international cases, the lack of finance for projects is a major barrier to the growth of renewable energy generation. KZN recognises this challenge and cites numerous funding sources, both domestic and international. This search for funding is cited as most effective when supported by the use of quality data collection mechanisms for reliable data that demonstrate emission reductions achieved; as well as thorough, well aligned strategies in line with provincial efforts. Local funding sources cited include:

- The Central Energy Fund (CEF)
- The Energy Development Corporation (EDC)- a division of the CEF
- Development Bank of South Africa (DBSA)
- Empowerment Through Energy Fund (ETEF)
- Investec Bank Limited. (KZN, 2007).

National, provincial and local government are already burdened with numerous development programmes, and so finding finances for the implementation of RETs, outside these structures would greatly assist the renewable energy effort. Under the Department of Energy (DoE) is the Designated National Authority (DNA) which is tasked with assessing “potential CDM projects to determine whether they will assist South Africa in achieving its sustainable development goals and to issue formal host country approval where this is the case” (DoE, 2013). Therefore a body already exists to give municipalities guidance on sourcing funds for climate change mitigation (KZN, 2007), more so from international sources such as:

- Macquarie Bank Africa.
- The Clean Development Mechanism (CDM)
- The International Finance Corporation (IFC)
- The International Bank of Reconstruction and Development (IBRD)

Reminiscent of the Nagpur Municipal Corporation, the KZN Department of Economic Development saw fit to recommend the “establishment of a mini-unit ... upon which the task falls of undertaking any activity necessary to drive Renewable Energy forward” (KZN, 2007: 64). In line with this notion, eThekweni Municipality (2008) recognises the need to establish an entity mandated with developing the municipality’s energy strategy.

Taking this one step further, is the development of an agency- a municipal entity, mandated with executing the components of the energy strategy developed.

Here again is the notion of creating capacity within the municipality, to manage and promote RE related activities. The efforts of the municipality, however minor in comparison to larger national programmes, present an opportunity for significant developments in the RE space when multiplied over the large number of municipalities countrywide.

EThekweni Municipality's own efforts were not unchallenged by barriers, especially with regard to the setting of feasible targets. The following are especially noted:

- Lack of good data: "[T]he lack of adequate data to establish and monitor a target is an obvious barrier" (eThekweni Municipality, 2008: 21). In terms of access to funding and accurate monitoring of a project's success, collection of quality data is commonly cited as an essential requirement - as noted in the case of India.
- Human resources and time: This is another obvious requirement, but a serious barrier if not addressed, as the collection, sorting and evaluation of data is essential.
- Target credibility: It is important to ensure that all end-users believe in the feasibility of the targets so that they are met and not written off as unachievable. Addressing this barrier will inform activities such as awareness campaigns that a municipality must run, both to assess the needs of citizenry and to create a conducive environment for RET implementation.

It is the author's opinion that lessons should not only include what worked, but also give insight into the challenges faced and then also how they were overcome. Presenting the implementation of RETs as a perfect, smooth option would be deceitful and could have negative impacts on perceptions as municipalities face challenges that were not anticipated.

3.2.4. Lessons at home - the case of the City of Cape Town

The City of Cape Town (CoCT) is presented here as a case closest geographically to Hessequa Municipality. Thus, CoCT and Hessequa Municipality have the opportunity to interact, especially through forums such as the Association of Municipal Electricity Utilities (AMEU). Despite CoCT being far larger and having access to more human resources and capacity than Hessequa, it can, like eThekweni still present some valuable lessons. CoCT has run numerous programmes in efforts to implement RETs and energy

efficiency measures, and has developed strategies to successfully guide the City's energy economy. Lessons from these efforts are highlighted below.

The Kuyasa project, famous as South Africa's flagship CDM project, saw the installation of 6300 SWHs in the community of Kuyasa, Cape Town (IEA, 2009). This relatively simple technology offers great benefits for both the municipality and members of the Kuyasa community, who will have access to more affordable heated water and can realise savings on their electricity bills. The project, registered with the CDM, generates revenue through the carbon emission reductions it achieves. A crucial factor for the success of many development projects is community ownership, and the Kuyasa project has been able to address this by requiring each household to contribute some fee to the installation costs. This is a valuable lesson: as projects often fall into disuse or are plagued by vandalism due to a lack of community buy-in, a notion alluded to in the case of Brazil.

Community ownership/buy-in is observed in lessons from CoCT's Kuyasa project.

The author's own observation of South African society, while highly limited, but also coming from the perspective of an external observer, is that there is a sense of entitlement, especially in previously disadvantaged communities. This has had the counter-effect of a lack of ownership in government programmes as a result of (a) the government's rollout programmes that have provided the masses with sub-standard services and technologies, and also (b) perhaps because of aspirations for what the advantaged minority of South Africans can afford. The situation is undoubtedly a result of the mechanics and memories of the apartheid era, and thus requires caution in terms of the implementation of mass rollout programmes to ensure buy-in and ownership. Here again, municipalities are best positioned to present more customized projects that the citizenry can relate to.

CoCT has also implemented a demand side management (DSM) pilot project, turning geysers off during peak demand periods. The programme reportedly resulted in estimated savings of 23MW, with a potential for 40MW if all geysers were switched off during peak demand times (CoCT, 2005). Such energy efficiency programmes are usually described as 'low hanging fruits' that should be looked into prior to venturing into more capital intensive and complex technology programmes such as PV installations. This is a further initiative that is open to municipalities, on the path of RE.

At the core of successful implementation is a well-structured guiding strategy. For this, the CoCT has its *Energy and Climate Change Strategy* which aims to "improve delivery and financial sustainability in City of Cape Town operations; improve air quality; reduce

greenhouse gas emissions; and promote economic and social development for the city” (CoCT, 2005: 5). In line with this strategy the CoCT established an Energy Committee in 2008 and then an Executive Management Team Subcommittee on Energy and Climate Change in 2011 (CoCT, 2011). The main lesson here is the need for effective strategies which foster a stable environment for investments and therefore the growth.

To fulfil the objectives of this study, an investigation into Hessequa’s own perspective of the barriers to the implementation of RETs and means of overcoming these barriers, will be conducted. The insights gained from this exercise will then be merged with the lessons outlined in the sections above, to produce final recommendations to the municipality and to all municipalities in general.

3.3. Gaining insights from Hessequa Municipality

To produce data that was relevant to Hessequa Municipality, which commissioned this study, and also to South African municipalities in general, it was necessary to gain the perspective of a municipality on (a) barriers to RETs and (b) the means of overcoming these barriers. To achieve this, it was decided that the literature survey presented in section 3.2 (which provides lessons on successful RET implementation) would supplement a case study of Hessequa Municipality. The use of a case study as a research method is discussed briefly in the next section.

It is important to define, here, what is referred to by RETs at the municipal level. These are energy technology systems including solar photovoltaic (PV) systems, solar water heaters (SWHs), wind turbines and bio-energy systems that the municipality can proactively work towards installing- either alone or in partnership with a private entity. The scope of these systems may include systems ranging from small-scale rooftop PV systems and domestic biogas digesters, to larger-scale systems that can feed into the grid. The size of the installation will depend on the user- for example, a household will install a smaller unit than a mall, which will generally install a smaller system than an independent power producer (IPP). What is, therefore, not specified in this discussion is the scale of RET systems that municipalities should consider, as this will depend on many factors.

3.3.1. The case study as a research method

Johansson (2003: 2) indicates that a “case study should have a ‘case’ which is the object of the study”, while the ‘case’ should (a) be a complete unit, (b) be explored in its natural setting with a numerous methods to allow triangulation, and (c) be contemporary. With regard to using Hessequa Municipality as a case study, this set of characteristics are met as the municipality was explored in its natural context as an extension of government tasked with the provision of services to its citizenry, in the here and now.

Johansson (2003: 6) further notes that often, the boundaries and even the focus of the case study “change through the research process”, and this was witnessed through the study of Hessequa Municipality. The initial focus of the research was to establish the technical renewable energy potential of the municipality, but through interactions with the municipality it was deemed more meaningful to investigate the barriers to the implementation of RETs, and explore the means of overcoming them. Johansson (2003:

6) also notes that “a case study focusing on a particular phenomenon might read as an investigation of a different phenomenon”, requiring the researcher to continually be aware of the ideas communicated and the meanings implied through the case study.

The idea of a case study’s focus changing throughout the research process is very relevant to this research study. What was initially proposed was a study to determine the RE potential of the Hessequa Municipal area, the focus changed to developing a roadmap for the implementation of RETs (which could have been a fully desktop-based study) and then it finally became a literature analysis combined with this case study of Hessequa Municipality.

Another insight gained through the research process, was the need for the researcher to be honest about their work. As Johansson (2003) notes, there is always the possibility of the researcher’s work being interpreted differently from the intention. What this calls for, much like the idea of emergence in complex systems theory, is not for the researcher to give up efforts at thorough research and writing, but to constantly be aware of and question the purpose of their work and the best way of communicating the ideas for this purpose.

The following basic characteristic features of case study methodology are provided by Johansson (2003):

- Triangulation: As mentioned, case study methodology employs various methods of research to ensure the validity of the data gathered, or rather, in the case of this qualitative research effort, the validity of the insights gained. In light of this, the literature survey presented in section 3.2 was used to draw parallels with insights gained from Hessequa Municipality, and to supplement these, especially in terms of the means of overcoming barriers to RET implementation.
- Selection of a case for study: There are two basic motivations for the selection of a specific case. The first is for the researcher’s intrinsic interest in the specific case, with no aim of making generalisations from the study. The second motivation is a purposefully selected case study that is considered to hold valuable insights which can then be generalised. The selection of Hessequa Municipality as a case follows this second motivation. Although the municipality itself commissioned the study, it subsequently evolved into work that would be relevant to all South African municipalities. This evolution of ‘motivation’ demonstrates the changing nature of the case study.

Having established Hessequa Municipality as the case, it was necessary to select an appropriate research method for the collection of information specifically from this municipality. This process is elaborated in the following section.

3.3.2. Selecting the nominal group technique method

The methods investigated to research the case of Hessequa Municipality were selected primarily as a result of the opportunities to interact with members of Hessequa Municipality. As part of the case study methodology, explained in section 3.3.1, it is essential that the case be studied within its natural context, requiring the researcher to engage with the staff of Hessequa Municipality in such settings. Thus, the research methods considered were: (a) the focus group method; (b) the Delphi Technique; (c) the Nominal Group Technique and (d) the use of a Brainstorming exercise.

The author felt that direct interaction with the municipality was the best way to gain the necessary insights into the municipality's context. Although time-consuming surveys and telephone conversations with various members of the municipality could have been conducted, they do not enable appropriate interpretation of responses to questions and suggestions as done with the Nominal Group Technique (NGT) exercise. Furthermore, the findings of the NGT were combined with insights from the author's prior interactions with members of Hessequa Municipality in October 2012

Morgan (1988: 21) asserts that the strength of focus groups lies in the opportunity they offer to gather information from "group interaction". Another advantage is that the researcher defines the discussion topics and so wields more control of the process. However, the researcher must remain flexible enough to allow the participants' discussion to bring new topics and concerns to light. Relevant to this research effort, Morgan (1988: 25) states that the focus group method allows the researcher to learn about "participants' experiences and perspectives".

The Delphi Technique is slightly more difficult to define precisely, according to Du Plessis & Human (2007). However, they state that the core of the Delphi Technique lies in facilitating group communication between experts, where there is a need for decision making on a specific issue. Du Plessis & Human (2007) cite Burns & Grove (2005) who define the Delphi Technique as "a method to measure the judgments of a group of experts, for the purpose of making decisions, assessing priorities or making foresights" (Burns & Grove, 2005, as cited in Du Plessis & Human, 2007: 15), as one of the various definitions of the Delphi Technique. An advantage of the Delphi technique is that it works to remove the bias in situations where "group dynamics, such as power and group pressure, might play a role in forcing individual group members to conform to group opinion" (Du Plessis & Human, 2007: 15). The distinguishing features of the Delphi

Technique are summarised as “anonymity, iteration and controlled feedback, statistical group response, and the use of experts as participants” (Du Plessis & Human, 2007: 16)

The NGT is used “in Brainstorming research in order to methodically generate and then sort creative ideas by their popularity, as judged by group members” (Boddy, 2012: 6). The NGT is said to be a refinement to Brainstorming group research, which is prone to “group think” or “peer pressure where people in the session are reluctant to share ideas for fear of ridicule” (Boddy, 2012: 7). To avoid this in NGT exercises the first stage in which ideas are generated is done individually and in silence. Boddy (2012) cites various studies which demonstrate that people working alone, in silence, generate a larger quantity of better quality ideas. Delp, Thesen, Motiwalla & Seshardi (1977) also reiterate this same idea. The NGT is limited, however, in that it diminishes cross-fertilization of ideas due to its structured nature. Therefore, the researcher must decide between losing the advantages of an exchange of ideas or gaining from the other advantages of NGT, as per the nature of the research problem and the envisioned data to be gathered.

Owing to various limitations, including limited time to (a) conduct the multiple focus group exercises, or any other activities of this nature, with Hessequa Municipality; (b) the lack of opportunities to perform one-on-one interviews with relevant personnel in Hessequa Municipality; and (c) the allocated date for executing the exercise being given at short notice, it was decided that the NGT would be the best research method to achieve the desired goals. The NGT was found to be both simple to conduct and time efficient. The ordered and anonymous nature of the technique also removed the possibility of the municipality’s hierarchy influencing the participation of the various stakeholders.

3.3.3. Conducting the nominal group technique (NGT) exercise

Delp et al. (1977) cite the following uses of NGT exercises, all of which are relevant to the aims of this study. These are:

- (a) to identify the elements within a problem, especially if these are social, cultural and political;
- (b) to rank them; and then
- (c) to facilitate the involvement of all relevant stakeholders to ensure acceptability of the conclusions of the exercise.

It was initially planned to conduct the NGT exercise with a select audience, namely: the Electrical Department Manager, the Finance Department Manager, the IDP Manager, the Consulting Engineer for Hessequa, and the Municipal Manager. The logic behind this selection was to conduct the exercise with stakeholders directly involved in the municipality's electricity business, who would therefore be involved in the implementation process and so have more insight into the municipality's challenges. However, the audience that finally participated in the NGT exercise was different from that initially envisaged.

At first this was deemed a limitation, but the author came to the realisation that the implementation process, even at the municipal level is influenced by various factors. Although the municipality is small and is less prone to the bureaucratic hindrances that national government would experience, it still has its share of stakeholders. At the very least the municipal administration's efforts are affected by the political will of the council, and it is therefore important to include the views of both parties. This was possible through the audience that finally participated in the NGT exercise.

The final attendees of the NGT exercise consisted of eleven individuals, representing: the Technical Services Department, the Municipal Manager's office, the Finance Department, the Office of the Mayor and councillors of Hessequa Municipality. Not only was the number of participants larger, but it also included the majority of stakeholders ideal for the study and additionally, councillors, who hold a strategic position in the municipality's decision-making body. Their participation in this exercise was of dual benefit by (a) allowing an increase in their interest and awareness of RETs-related activities within the municipality, and (b) by affording this study access to their views and opinions.

Delp et al. (1977) provide a thorough, yet simple outline for conducting an NGT exercise. This was adapted and used for the exercise with members of Hessequa Municipality. The following is a brief description of the NGT exercise conducted.

Stage 1:

This stage focused on determining the barriers to municipal implementation of renewable energy generation projects. To achieve this, the following steps were followed:

The participants were asked the following question: *What are the barriers to the municipality implementing renewable energy generation projects?*

A brief explanation was given to the participants that renewable energy generation projects referred to more such projects as the municipality's PV plant and the encouragement of more rooftop PV systems- both of which the participants were aware of.

- As per the NGT, participants were given five minutes to respond to the question posed, individually and in silence. This was emphasised to the participants.

(It must be noted here that the majority of the NGT exercise was conducted after a presentation on “*Unlocking the rooftop PV market in South Africa*” (Reinecke et al., 2013). Thus, in order to minimise the contamination of the NGT exercise, this initial question was posed and participants answered, prior to the presentation).

- Participants' responses were read out to the whole audience - in case any clarifications were needed, or if a participant felt they needed to clarify their suggestion further.
- Then the responses were grouped into thematic clusters, with participants' assistance.

This third step, and the rest of the NGT exercise, was conducted after the presentation by the CRSES.

- Participants were then asked to rank their top five thematic clusters using stickers numbered ‘1’ to ‘5’, which they stuck within the respective cluster. Participants were instructed to perform this step individually, without discussion.

Stage 2:

The CRSES's presentation, conducted prior to this stage, was not deemed a possible contaminant to the results of this exercise. Nevertheless, it is noted that the presentation was given shortly before this stage of the NGT exercise. This stage sought to determine ways to overcome barriers to municipal implementation of renewable energy generation. Again, this was achieved via the three-step process, described below.

Participants were asked the question: *How can the barriers to municipal implementation of renewable energy generation projects be overcome?*

- The participants' responses were again collected, read out aloud, to all participants, and posted on display in thematic clusters.
- Participants were then asked to rank their top five thematic clusters by placing numbered stickers within the respective thematic clusters.
- Similar to stage 1, the participants were asked to respond to the questions, and rank the 'themes' within which their responses were categorised, individually and in silence. Discussion of the results of the exercise is conducted in section 3.4.

3.4. Results and discussion of the NGT exercise

This section presents and interprets the data gathered from the NGT exercise described in section 3.3.3.

3.4.1. Presentation of results

The data gathered from both stages is summarised in Table 3-2 and in

Table 3-3. The ranking system used to determine the top 5 themes, as per the participants, is described in Table 3-1.

Table 3-1: Ranking method used to produce top five themes

Ranking method:

Rank:	Assigned weight:
1	5
2	4
3	3
4	2
5	1

The participants were asked to rank their top five themes in decreasing order of priority (with a ranking of 1 representative of the highest priority). This ranking was then assigned a value of five, while a ranking of 5 was assigned a value of one. Thus, after all the ranking had been done in both stages (see Figure 3-4 below) the data was collected, tabulated and the ranks assigned to each theme added up (refer to Appendix C: Nominal Group Technique data).

The 'Breakdown' column in Table 3-2 below was used in section 0 to discuss the trends observations from the ranking activities. Though the NGT exercise is not strictly quantitative, the quantitative data gathered therein is worth discussing as a means of further exploring the views and opinions expressed by participants.

Figure 3-4: Visual of the responses and rankings during the two stages of the NGT exercise



Table 3-2: Summary of data from Stage 1 of NGT exercise

Barrier:	Breakdown: (RANK- votes received)	Score:	Ranking
Lack of funds to implement RE generation projects	1- six; 2- one; 5- two	36	1
General lack of information and knowledge on RETs	1- two; 2- five; 3- one	33	2
(Possible) negative impact of RE generation on municipal revenue	2- one; 3- four; 5- two	18	3
Negative perceptions and public opinion of technology	1- one; 2- one; 4- three; 5- one	16	4
Lack of suitable human resource/ capacity in the municipality	3- one; 4- two	7	5

Table 3-3: Summary of data from Stage 2 of NGT exercise

Suggestion to overcome barriers:	Breakdown: (RANK- votes received)	Score:	Ranking:
Creation of capacity within the municipality	1- four; 2- five; 3- one; 4- one	45	1
Financial support of municipality by government	1- two; 2- two; 3- one; 4- two; 5- one	26	2
Provision and creation of guiding regulations	2- one; 3- one; 4- three; 5- three	16	3
Informing and engaging the public	1- two; 2- one	14	4
Mechanisms to counter revenue loss	3- four; 5- one	13	5

3.4.2. Discussion of results

Stage 1 of the NGT exercise sought to determine what the municipality perceived as barriers to the implementation of renewable energy generation. To determine this, the ranking of participants' responses was collated into Table 3-2 above, with the scores generated as described in the section above. A simple tally of the rankings results in the general theme of *Lack of funds to implement RE generation projects*, being ranked as the top barrier, followed closely by *General lack of information and knowledge on RETs*. However, breaking down the actual ranking offered more insights into the perceptions of the participants. The top ranked theme was evidently the most important, with both the highest number of votes and a clear trend of it being assigned a ranking of 1. However, it was interesting to note that two participants gave this theme a ranking of 5, while the 5th ranked theme, *Lack of suitable human resource/capacity in the municipality*, is only placed 5th due to a low number of votes- it has no actual ranking of 5. It is thus noted that further discussions with the participants, attempting to understand *why* they have ranked themes the way they have, would be useful to better understand the municipality's perspective of the barriers to RETs. Nevertheless, from the municipality's perspective, as per the results of the first stage, the two major barriers to the implementation of renewable energy generation are: (a) a lack of funds, and (b) a lack of knowledge about RETs. It is interesting to note that a lack of human capacity/ technical capacity was only ranked 5th by the participants, and is a possible reflection of the stage of the technology learning journey that Hessequa Municipality has reached - a stage where a general understanding of the technologies is required, even before the technical aspects of implementation are considered.

Stage 2 sought to determine possible means of overcoming the barriers highlighted by stage 1, again as per the perspective of Hessequa Municipality. A similar process of collating the rankings of the participants led to the results described in Table 3-3. Tallying up the votes indicates that the suggestion to *Create capacity within the municipality*, is by far the top suggestion, with both the highest number of votes (eleven) and the highest number of rankings of 1 (four). This theme far outstrips the 2nd ranked suggestion, namely, *Financial support of the municipality- by government* - with the former scoring 45 points, while the latter scored only 26 points. What is immediately interesting is the reversal of themes between barriers and suggestions of means to overcoming them. While the top barrier to implementing RETs is a lack of finances, and

the 5th ranked barrier is perceived as a lack of capacity, the top suggestion for overcoming these same barriers is the building of capacity within the municipality, followed by financial support from national government. Again, it is recognised that further investigations to establish the cause of these apparent discrepancies are required to better understand the municipality's perspective - therefore enabling better informed recommendations on ways forward.

3.4.3. Limitations to the NGT exercise

In addition to the limitations cited in section 3.3.3 other limitations were experienced during the actual proceedings of the day as discussed below.

One of the advantages of the NGT is that it generates a greater quantity of better quality responses by having participants work alone, in silence (Boddy, 2012). This, however, was not completely achieved. Despite the facilitator instructing participants not to verbally interact during the exercise, it was observed that some participants engaged in discussions or simply copied some ideas generated by their neighbours. This limited both the number of suggestions generated and their quality. Given the participants' roles and positions in the municipality and also the inexperience of the facilitator in conducting such an exercise, it was difficult to strictly control the group. It was noted that the participants, in their natural environment are accustomed to working together, often by discussing issues at hand.

Another limitation to the exercise, though minor, was the language barrier between the facilitator and some members of the audience. The exercise was conducted in English, whereas some of the participants, though able to speak and understand English, were more accustomed to communicating and expressing their ideas in Afrikaans. Thus, some of the responses generated during the exercise were written in Afrikaans, requiring translation before the suggestions were read out to the rest of the group and categorised. It may be the case, therefore, that some of the ideas and meanings that the participants attempted to convey were somewhat 'lost in translation'.

Thirdly, owing to the author having expected a specific audience with which to conduct the NGT exercise, the unexpected composition of the actual participants is felt to have reduced the effectiveness of the exercise. This was not as a result of the participants themselves, but rather a result of the structure of the exercise being limited. It is felt that with prior knowledge of the participants, the exercise could have been designed to gain

more insights from the mixed audience present, whereas in the form it was in, it did not take advantage of the whole audience.

The author's initial view, as explained, was that the final audience weakened the insights gained, but in retrospect this perspective changed into a realisation that the tools employed were inadequate for the material present. The research effort, it seems, is never presented with 'bad' experiences, but is rather, sometimes, plagued with poor choices of tools. It is therefore up to the researcher to be aware of different possibilities, and to approach data and its interpretation with this in mind.

3.4.4. Conclusions drawn from the NGT exercise

The main conclusions drawn from the NGT exercise, in line with the objectives of this study, are in terms of the barriers to municipal implementation of RE generation projects and the possible means of overcoming these barriers. The major barriers, as per the views of the stakeholders engaged, were found to be:

- a) a lack of funds to implement renewable energy generation projects; and
- b) a general lack of information of, and knowledge about RETs.

As observed in some of the local and international cases explored, a lack of funding is a common barrier to the implementation of RE generation projects. A further insight, unique to Hessequa Municipality, but by no means limited to Hessequa, is that a lack of information and knowledge about RETs is a major barrier. In fact, this is evident in yet another common theme in the various case studies, namely the importance of creating capacity within municipal structures to manage RE related activities.

The top suggestions for possible means of overcoming these barriers were found to be:

- a) the creation of capacity within the municipality; and
- b) getting financial support from government.

That the same suggestions put forward here to overcome barriers are the same themes that resonate throughout the other case studies explored, confirms that Hessequa Municipality's experience of challenges to implementing RETs is the same as that of many local governments the world over. Moreover, this resonating theme indicates that the recommendations emanating from this study will be relevant and useful to Hessequa Municipality's efforts to achieve sustainable development, and so too to other South African municipalities.

3.5. Conclusions

The objectives of this case study, as highlighted in section 3.1.2, are:

- To provide relevant lessons to municipalities from cases of successful implementation of renewable energy generation in international and local case studies.
- To determine the municipality's perspective on the barriers to municipal implementation of renewable energy generation, and
- To determine possible means of addressing these barriers; linking the municipality's perspective on possible means of doing so with lessons from other case studies.

In line with these objectives, section 3.2 provides an array of lessons from various international and local cases of RET implementation. The resounding themes throughout the cases explored are:

- That it is essential to ensure community ownership and buy-in of projects proposed.
- That a lack of project funding can be addressed by the creative use of existing policy such as through the creation of appropriate PPPs.
- That there is a need to create capacity within the municipality to effectively manage RET implementation activities.
- That the municipality should work to align itself with provincial and national government efforts, while also working to influence these same efforts.
- That local government level-led policy initiatives are more effective as they are better able to meet the needs of the citizens affected

The author observes that Hessequa Municipality is already making significant progress. What is perhaps needed now is the creation of a responsible body within the municipality, either as a designated department within the structures of the municipality, or through a separate entity tasked with facilitating the implementation of RETs on behalf of the municipality.

In line with the notion of municipalities leading the RET implementation process, the International Energy Agency (IEA, 2009: 16) notes that:

“...local authorities can serve as a vehicle to implement top-down policies from national governments, deliver meaningful results, and ensure national mandates are carried out. They can design solutions to climate change that are adapted to the needs of local constituents and are consistent with local policy priorities”.

As per the results of the NGT exercise discussed in section 3.4, Hessequa Municipality perceives the main barriers to their implementation of RETs to be:

- (a) a lack of funds to implement renewable energy generation projects; and
- (b) a general lack of information of, and knowledge about RETs.

The objective of this study was to consolidate suggestions from Hessequa Municipality on means of overcoming barriers to the implementation of RETs with lessons learnt from the other cases explored. This has been done through the discussion, with common themes highlighted and aligned with the ultimate argument put forward by the author, namely that municipalities have the opportunity to take a leading role in the implementation of RETs in South Africa. Though this effort is secondary to their addressing the municipal dilemma, it is an opportunity to make significant contributions to the national sustainable development effort. What must follow this study, is an investigation into *how* municipalities must move forward. Having established that the municipal dilemma, beyond being a challenge to the municipality, presents an actual opportunity, what is needed is a practical approach to moving towards RETs at the municipal level. Perhaps through a case study of an RE project developed by a municipality, guidelines on overcoming the various hurdles present can be developed, also taking cognisance of the findings of this study.

From a complex systems theory perspective, municipalities with their strategic proximity to the citizenry, have the opportunity to act as information portals for the larger system, informing policy-making for renewable energy. By creating localised by-laws that facilitate the growth of RETs and through engaging with provincial and national bodies to push for more effort towards enabling RETs, municipalities can be at the centre of reinforcing feedback loops within the larger South African context. This will see them:

(a) fulfil their constitutional mandates to provide basic services; (b) circumnavigate the possible financial risks of implementing RETs; (c) resolve the regulatory ambiguity surrounding generation and electricity reticulation and (d) implement RETs as a means of ensuring their financial sustainability while significantly contributing to national climate change mitigation efforts.

The International Energy Agency recognises the potential of municipalities, noting that municipal efforts,

“...can help build resilience to climate change in the urban infrastructure. Experimentation on new forms of policy at the local level can provide learning and experience and, when successful and where appropriate, can lead to bottom-up diffusion of approaches between cities, as well as at the national and international level IEA” (2009: 16)

Chapter 4: Conclusions and recommendations

4. Addressing the municipal dilemma

The ultimate aim of this study is to assist municipalities in addressing the municipal dilemma, described as the nexus between (a) municipal mandates to provide basic services; (b) the possible financial risks of implementing RETs; (c) the regulatory ambiguity surrounding electricity generation and distribution jurisdiction; and (d) the necessary implementation of RETs as a means of addressing the growing risk of revenue loss from reduced electricity sales as consumers install their own RETs as a contribution to national climate change mitigation.

To achieve this, the study sought to gain an understanding of the barriers to the implementation of RETs in South Africa, both at a higher, national level, and from the perspective of the municipality. This dual perspective on barriers sought to provide insight into the municipal effort vis-à-vis national efforts to implement RETs. This has led to exciting possibilities for municipalities to not only address the municipal dilemma but make significant contributions to the sustainable development effort through spearheading the implementation of RETs.

The study also looked to highlight existing policy opportunities for municipalities to implement RETs and to correlate these with (a) suggestions from Hessequa municipality on what is required to enable the municipality's RET implementation effort; and (b) with lessons from other international and local cases of RET implementation. The aim of this correlation was to find common themes in the implementation of RETs that resounded with policy already in place. This allowed the study to make assured recommendations for further implementation of RETs by Hessequa Municipality, and ultimately by all South African municipalities.

The sections below link with the findings of the literature analysis conducted in Chapter 2, with the insights gained from the case study of Hessequa Municipality in Chapter 3.

4.1. Develop appropriate policies

A common theme among the literature reviewed, both in Chapters 2 and 3, has been the usefulness and need for localised policies in the implementation of RETs. This is directly in line with the argument that this study makes, namely that municipalities have the opportunity to take advantage of their position close to the citizenry to implement RETs and then transfer this knowledge to the larger systems to achieve the bottom-up diffusion of policy that the IEA (2009) recommends. What this is hoped to achieve is: to address the municipal dilemma, while also offering the larger system a more updated perspective of the needs of the end-consumer of energy, thereby helping to shape development of the country's energy economy.

NERSA's *Standard Conditions for Embedded Generation within Municipal Boundaries* (NERSA, 2011; EE Publishers, 2012) is evidence of such an occurrence, where municipal level action resulted in action from national institutions. The conditions outlined in the document, are said to be a result of awareness that since 2008 "there has been a significant increase in the interest in installing this kind [renewable energy] of generation" (NERSA, 2011: 3). Calls from the CoCT and Nelson Mandela Bay Municipality for NERSA to provide clearer regulations on electricity generation via RETs in their respective jurisdictions also contributed to this reaction by the provincial and national government. By actively engaging with both provincial and national government, municipalities will be able to overcome issues of overlapping jurisdiction - a process already accounted for in legislation (refer to section 2.4). In support of this suggested effort, the IEA (2009: 17) states that "[n]ational governments therefore need to stimulate action at the local government level in order to fully integrate renewable energy and climate considerations into urban development strategies". Thus the call is upon municipalities to proactively create by-laws within their jurisdiction and continuously engage with and influence the policy-making process at provincial and national government level. The literature analysis in Chapter 2 demonstrates the presence of policy that is already conducive to RET implementation, so making it easier to follow the procedure.

4.2. Develop well-aligned, long-term energy and climate change strategies

It is already required of municipalities to develop Integrated Development Plans which are revised yearly. These plans themselves are informed by departmental Master Plans within the municipality - which often comprise twenty year visions; much longer than the electoral cycles for local government. What is called for here, as a result of the various case studies explored, is a strategic alignment of municipal development plans with provincial and national strategies. In addition to aligning their strategies with national plans, municipalities must develop highly detailed energy and climate change strategies in which,

- (a) an assessment of the RE resources, future energy demands and costing of technologies is done prior to promoting the use of RETs, such as the rooftop PV potential study conducted for Riversdale by the CRSES;
- (b) Studies into the specific needs of the municipality's citizenry are conducted, as a means of ensuring effective and relevant plans; and
- (c) Pro-active planning to develop local economies is done, and not left to chance.

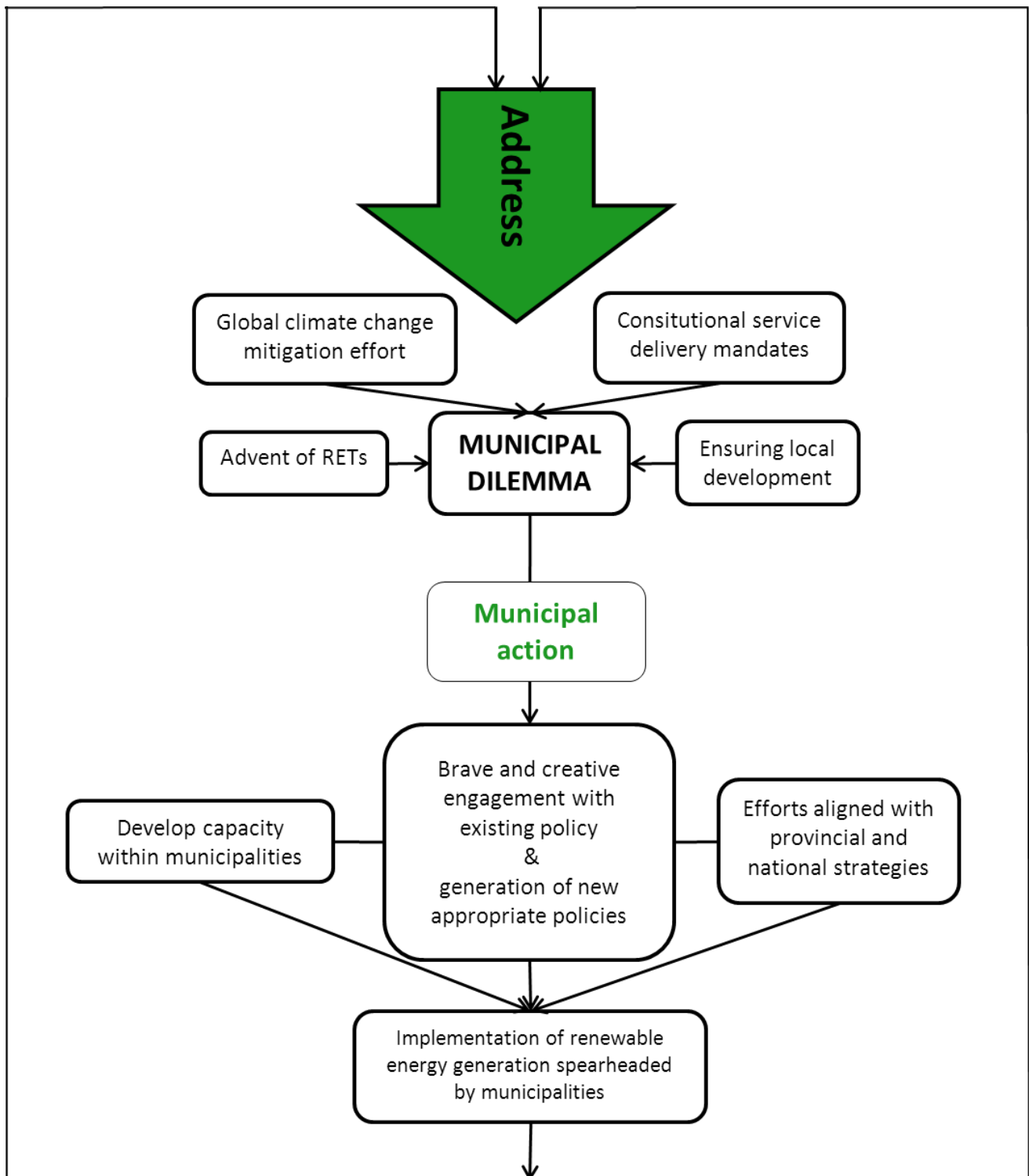
In line with the suggestion for municipalities to generate their renewable resource maps, the IEA (2009: 97) asserts that ideally "the target level needs to be achievable but at a stretch, so this first requires some good analysis of the available renewable energy resources and comparative costs of the technology". Developing detailed and aligned long-term strategies has the dual benefit of ensuring that municipal plans are well supported by provincial and national government, and of also increasing municipal competency with respect to project implementation. Sebitosi & Pillay (2008b) indicate that policy consistency is essential to the process of implementing RETs, as it creates a supportive environment for growth. This theme runs throughout the cases explored, expressed either as (a) the importance of undergoing a thorough long-term strategy development process in line with, and guided by national and provincial targets and programmes; or (b) the establishment of a separate entity tasked with managing the RET growth process, thereby ensuring continuity. Both these processes enable the continuous and consistent creation of policies conducive to RETs, and furthermore allow for the appropriate adjusting of policy informed by experience.

4.3. Develop municipal capacity

The notion of developing capacity, suggested as the most important factor for overcoming barriers to implementing RETs by Hessequa Municipality is crucial to successful implementation. It was also a common theme among the other cases explored. In Nagpur, India, the renewable energy growth effort began with simple projects such as powering street lights and traffic lights with small-scale solar units, and the installation of SWHs. As the municipality gained experience, both technically and in terms of managing the implementation process, larger and more complex projects could be explored. According to Hessequa Municipality, the lack of information and knowledge on RETs is a major barrier to municipal implementation of renewable energy generation. Thus, awareness campaigns to inform both the public and key personnel within the municipality itself are a good starting point.

The next step along this path would be developing the requisite technical capacity in the local municipality, as it was noted that the ability to set well informed targets and to collect, monitor and evaluate good quality data is essential to the success of executing set strategies. Not only does this increased capacity allow for effective project development, but the collection of good quality data is crucial in garnering funds for RET projects, especially under the banner of climate change mitigation. This follows on from the notion of municipalities creating well aligned, long-term strategies that ride on national efforts to achieve sustainable development, further unlocking funding avenues for project development. Thus, municipalities must consider developing such capacity, either through (a) training staff, (b) establishing a separate municipal entity responsible for all renewable energy and climate change related projects – if it can be financially supported, or (c) by entering in appropriate PPPs - all of which are supported by already-existing policy.

Figure 4-1: The author's visual depiction of the process of addressing the 'municipal dilemma'



Trollip et al. (2012: 12) indicate that “within the 5 to 10 year period PV technology will reach grid parity with conventional technologies, making the question at hand not whether municipalities need to embrace renewable, but rather *how* they should embrace these technologies”. This study, from the insights gained through the literature analysis

of South Africa's energy and municipal management legislation, considering the municipality as embedded within a larger complex system, and through a case study of Hessequa Municipality, recommends that municipalities not only embrace RETs, but spearhead their implementation. As Figure 4-1 depicts, not only does the municipal dilemma require a response from municipalities, it also presents a unique opportunity for the South African municipalities to reinvent their role within the national context. By taking the appropriate actions, as recommended by this study, municipalities can close the loop on the municipal dilemma and use the changing global and national context in energy to reposition themselves as, (a) custodians of sustainable development; (b) providers of constitutionally mandated services; (c) economic developers of their citizenry; and (d) contributors to national efforts through the implementation of renewable energy technologies.

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Appendices:

Appendix A: Barriers to RETs

Figure A-1: Barriers to renewable energy

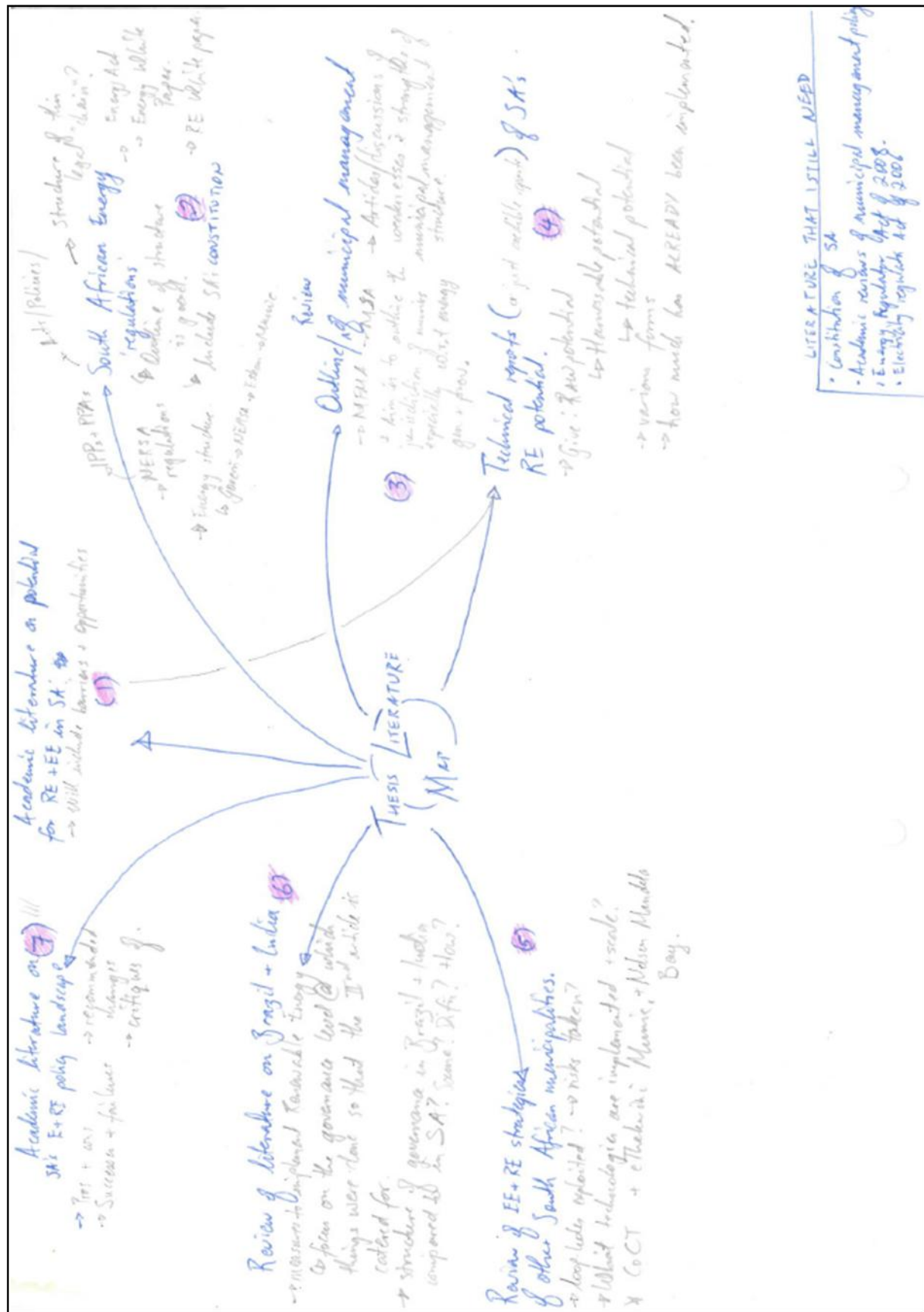
Barriers to RETs penetration ^{a,b}		
Barrier category	Barriers	Remarks
1. <i>Market Failure/imperfection</i>	Highly controlled energy sector	This may lead to lack of investments in RETs.
	Lack of information and awareness	It increases uncertainty, and hence costs.
	Restricted access to technology	Technology not available or available at high cost.
	Lack of competition	Product cost increases.
	High transaction costs	Economic viability of the project may be affected.
	Missing market infrastructure	It may increase cost of product to the consumer.
	High investment requirements	This acts as an entry barrier for entrepreneurs.
2. <i>Market Distortions</i>	Favour (such as subsidies) to conventional energy	This affects competitiveness of renewable energy adversely.
	Taxes on RETs	Cost of energy from RETs increases.
	Non-consideration of externalities	Cost of conventional energy is less than what it should be.
	Trade barriers	Cost of RETs may go up, for example due to high taxes on RET imports.
3. <i>Economic and Financial</i>	Economically not viable	Cost reduction in RETs needed.
	High discount rates	Incentives may be needed in the initial stages.
	High payback period	Project becomes un-viable.
	Market size small	Economy of scale cannot be achieved.
	High cost of capital	It may affect economic viability.
	Lack of access to capital	No. of producers less, and hence competition and market efficiency may suffer.
	Lack of access to credit to consumers	It may reduce market size.
	High up-front capital costs for investors	Capital costs may also go up due to increased risk perception. Adverse effect on competition and efficiency.
	Lack of financial institutions to support RETs, lack of instruments	Supply of RET products may suffer. Adverse effect on competition and efficiency.

(continued on next page)

Barrier category	Barriers	Remarks
4. <i>Institutional</i>	Lack of institutions/mechanisms to disseminate information	It leads to non-availability of information with producers as well as consumers.
	Lack of a legal/regulatory framework	Renewable energy producers may face market/economic/financial barriers without this.
	Problems in realising financial incentives	This may be due to red tape, leading to economic/financial barriers.
	Unstable macro-economic environment	This may increase risk and uncertainty for new investments. Only products with low payback period may be acceptable.
	Lack of involvement of stakeholders in decision making	This can result in mis-placed priorities.
	Clash of interests	This may lead to powerful lobbies against RETs.
	Lack of R&D culture	This may make adaptation of technology difficult.
	Lack of private sector participation	Lack of competition and inefficiency is possibly due to this.
	Lack of professional institutions	Producers' problems and views on barriers cannot reach the policy makers effectively.
5. <i>Technical</i>	Lack of standard and codes and certification	Product quality and product acceptability is affected. Purchase and commercial risk increases, as also negative perception about technology.
	Lack of skilled personnel/training facilities	This can be a constraint for producers.
	Lack of O&M facilities	This can affect product acceptance.
	Lack of entrepreneurs	It may lead to lack of competition and supply constraints.
	System constraints	Market can not be realised by producers.
6. <i>Social, Cultural and Behavioural</i>	Product not reliable.	Market size may get affected.
	Lack of consumer acceptance of the product	Market size becomes small.
	Lack of social acceptance for some RETs	Affects market size. For example, gas from urban waste for cooking may not be acceptable to a sizeable segment.

(Source: Painuly, 2000)

Appendix B: Original literature map



Appendix C: Nominal Group Technique data

Table C-1: Data collected from NGT exercise with Hessequa municipality- Barriers to RE generation projects

<u>Ideas generated:</u>	<u>Thematic grouping</u>	<u>Votes</u>	<u>Score:</u>	<u>Ranking</u>
Loss of income	(Possible) negative impact of RE generation on municipal revenue	5,3,2,3,3,3,5	18	3
possible negative income of loss of income if private generation increases				
impacts on municipal revenue				
Uncertainty- how will it influence the municipality's income electricity sales				
Measuring in/out	Measuring generated electricity	4	2	
Previous disappointments	Negative perceptions of technology and public opinion	4,5,4,2,4,1	16	4
Community mind-set				
Public opinion				
Insecurity				
Perception of public				
Source (of renewable energy)	Sources	-	-	-
Getting the energy from the municipality to the grid/user	Reticulation infrastructure for RE	3,3,5	7	5
Infrastructure required to receive/distribute alternative energy				
Sustainability in the local area	Local benefits of RE generation projects	5,4,4	5	7
The area next to where the project will be				
The areas where it will happen				
job creation complications				
Will there be a benefit to local people				
Environmental concern	Concern over environmental impacts of RE generation projects and government regulations and approval	2,5	5	7
Environmental impact				
Approval from department of planning and of Environment				
Licensing				
Approval from DoE				
Frustration of our efforts with NERSA, Eskom + government				

Red tape/ regulations				
Inability of DoE to give guidelines on renewable energy				
Land	Land	-		
Land				
Lack of fit-for-purpose people	Lack of suitable human resource/capacity in municipality	4,3,4	7	5
Trained people				
People with knowledge				
Capacity, i.e. knowledge of the technology at the municipal level				
Information				
Shortage of environmental studies on the region				
lack of information/guidelines on carbon credits				
Lack of enough information				
Knowledge	General lack of information and knowledge on RETs	2,2,2,2,2,1,1,3	33	2
Knowledge of subject area				
Not enough knowledge				
Lack of knowledge on the subject				
Finances	Funds to implement RE generation projects	1,1,1,1,1,1,2,5,5	36	1
Finance				
Money				
Money				
Cost				
Lack of funding/ insufficient funds				
Lack of funds to start- difficult to work with private partners in terms of MFMA				
Finance- MFMA restrictions; Budget constraints	MFMA restrictions	4,5,3	6	6

Table C-2: Data gathered from NGT exercise with Hessequa municipality- overcoming barriers to RE generation projects

<u>Ideas generated:</u>	<u>Thematic grouping</u>	<u>Votes</u>	<u>Score:</u>	<u>Ranking</u>
Gas proposed to users to use it for saving	Use of alternative energy sources	-	-	-
use diesel generation for geysers etc				
Use gas				
Generators				
Storing of renewable energy	Storage	5,5,5	3	8
Install solar panels in different towns	Installation of solar panels	4,3	5	7
Put up solar panels				
Gather information on: users; areas; network	Gathering of information	-	-	-
Just do it!	Proactivity	1,5,4	8	6
Utilisation of MFMA and the opportunities it creates				
Install prepaid meters	Installation of prepaid meters	3	3	8
The implementation of prepaid meters				
Employ service providers to do maintenance to ensure cost effectivity	Use of external entities	4	2	9
Regulations for renewable energy	Provision and creation of guiding regulations	2,3,4,4,5,5,5	16	3
Regulate the quality of inverters				
Eskom + NERSA make up their minds on what they want- regulations, price, etc				
Regulations				
Regulate the buying of excess electricity from PV owners	Mechanisms to counter revenue loss	3,3,3,3,5	13	5
Enough uptake to ensure lower peak-demand Eskom usage, to counter loss in income				
Payment of a basic fee for network use	Creation of capacity within the municipality	2,1,1,3,2,2,2,1,4,1,2	45	1
Provision on organogram for capacity creation				
Training of staff				

Municipality participating in process at provincial and national level to learn as much as possible				
Get the know-how from institutions that specialise in renewable energy				
Training on the issue of renewable energy for staff and councillors				
Training of staff- technical and financial				
To identify the necessary resources	Identification of RE resources	-	-	-
Public negotiations	Informing and engaging the public	1,1,2	14	4
Information				
Consumer education				
Information to be made public, public participation				
Inform community				
Inform people how or where to get finances for projects	Financial support of municipality; by government	1,2,1,4,4,5,2,3	26	2
Incentives				
Funding from national government				
Subsidies- from government and Eskom				
Government subsidies for both municipality and public users				
Capital budget for infrastructure upgrades				
To have enough funding				
Organise (acquire) finances				